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W. A. HARDENBERGH and A. PRESCOTT FOLWELL
Editors

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The Editor's Page

James T. Morris

On June 4, James T. Morris died. He had been a part of PUBLIC WORKS, and PUBLIC WORKS had been a part of him, for over forty years. His going leaves a gap that cannot be filled. He was a gentleman in all that the word implies, and his presence was one of the reasons why few folks ever left PUBLIC WORKS, for he lent to it a kindliness and a dignity not often found in present-day business. He had been president of PUBLIC WORKS since 1930, and for many years before that he was its general manager. His eternal youthfulness of spirit and his unbending honesty and straightforwardness were the envy and the admiration of the younger folks he liked to have around him, and were essential factors in developing the broad policies on which PUBLIC WORKS has been built—helpfulness and consideration toward all, strict moral and business honesty, continued progressiveness, and technical soundness. These policies will be continued; and with them we shall strive always to maintain that spirit of kindliness, friendliness and fair play which was the outward evidence of his inner qualities. The organization that he built will carry on, but we all will continue to miss him greatly.

Getting Ready for Winter

Most of our readers will be wiping sweat from their brows as they turn this page, and icy streets and snowbound roads probably will be farthest from the thoughts of many of them. But now is the time to plan for winter problems. First, about snow plowing equipment, both blades and motors. We all know that the war years took a terrific toll of such equipment, and that inadequate quantities of replacements were available last year. What are the replacement needs for this coming winter? Probably most communities will still be short. Then how about strengthening the fleet with two-way radio? Experience has shown that ability to communicate directly with plow operators results in greatly increased efficiency of equipment and reduces time lost due to breakdowns. Under any condition, the needs for the coming winter should be investigated carefully and every effort made to meet them, including selecting and training personnel.

Second, about ice control measures. Proper ice control also takes top-notch advance planning and administration. Sites for grit storage must be selected and perhaps storage facilities; the grit must be obtained; salt or calcium chloride must be available; spreaders and motor trucks must be ready. Personnel must be selected and trained.

Last winter the nation had some costly object lessons in losses due to snowstorms for which inadequate preparation had been made. Parsimony in government works fine—for a while, and then the citizen pays through the nose for it. We believe in economy and in good management for all governmental units, but we don't believe in starting a winter with worn-out trucks, inadequate plows and untrained personnel.

The Importance of Engineers in National Defense

In the recent war, the United States made the greatest use of any nation of its engineering and scientific skills. In the future, these skills will probably be of even greater importance. In recognition of this, two of our major engineering societies have appointed committees to study the matter of utilization of engineering personnel within the armed forces and to attempt to work out a program whereby the engineering field can contribute most effectively to national defense. These societies are the American Society of Civil Engineers and the National Society of Professional Engineers. This editor is chairman of both these committees.

Despite the effectiveness of its engineering services, it is a well recognized fact that the nation did not utilize its engineering personnel to the maximum. Nearly everyone knows of cases where engineers were employd at non-engineering work, while men whose only training consisted of three or four months work at an Army engineer school were assigned to jobs requiring a broad background of engineering experience and skill. It is to reduce to a minimum cases such as these, and to investigate the broader fields of professional cooperation between military and civilian groups, that the engineering societies have set up this long-range program. Such a program has long been needed, for in times of peace military and civilian engineers tend to drift apart; and in emergencies valuable time and effort are lost in getting together again.

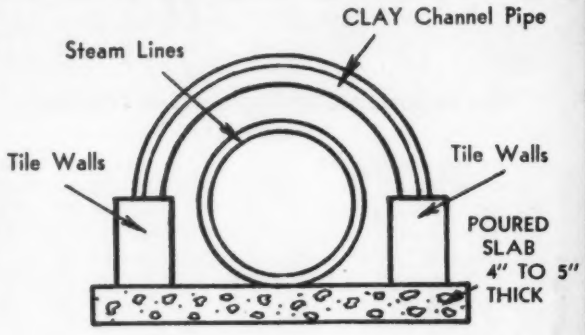
Sanitary Engineering in the Army

This is a subject that we have discussed before, and we can summarize the present status of the matter simply by saying that there isn't going to be any, to all intents, purposes and appearances. The bill to merge the engineers and other technical men into the catchall and inferior Medical Service Corps will possibly have been passed by the time these lines are published. Sanitary engineers and others put up a marvelous fight, and until the Navy yielded to the Army demands for a similar second-rate corps in the Navy, there was every indication that the fight had been won. However, the victory is a hollow one for no intelligent engineer, now that he knows what he is going up against, is likely to accept appointment in the Medical Department.

The fight against the Medical Service Corps finally developed a very strange political alliance between the doctors in power in the Medical Department and the pharmacists, whereby the former got the powerful political backing of the latter, and the pharmacists got their own way as regards the Medical Service Corps, and an upper hand in it, of course.

The support accorded by the hundreds of engineers who took part in this fight for a fair deal and for better national defense will never be forgotten. The next phase of the fight is now shaping up. This matter is too vital and too important to give up now.

ENGINEERS DISCOVER NEW USES FOR CLAY PIPE



CLAY CHANNEL PIPE TUNNEL PROTECTS UNDERGROUND LINES

Cross-sectional diagram shows how engineers of the Birmingham Electric Company in Birmingham, Alabama use Clay Channel Pipe to protect and insulate underground steam lines. Chemical-resistant Clay Channel Pipe is grouted with mortar to structural tile sidewalls set on a poured base. This forms a "tunnel" for the magnesium-jacketed steam lines. The Clay Pipe offers good protection against the dampness of the earth, and it can easily be removed to provide quick access for repair or inspection of the steam lines. Such excellent results have been obtained that Birmingham Electric plans another similar installation of 2800 feet of Clay Pipe.

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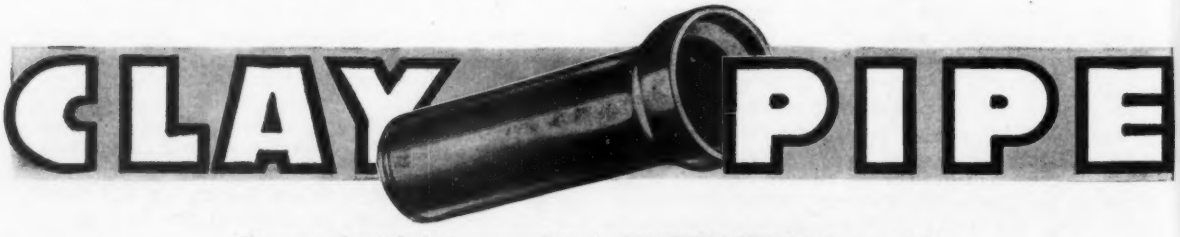

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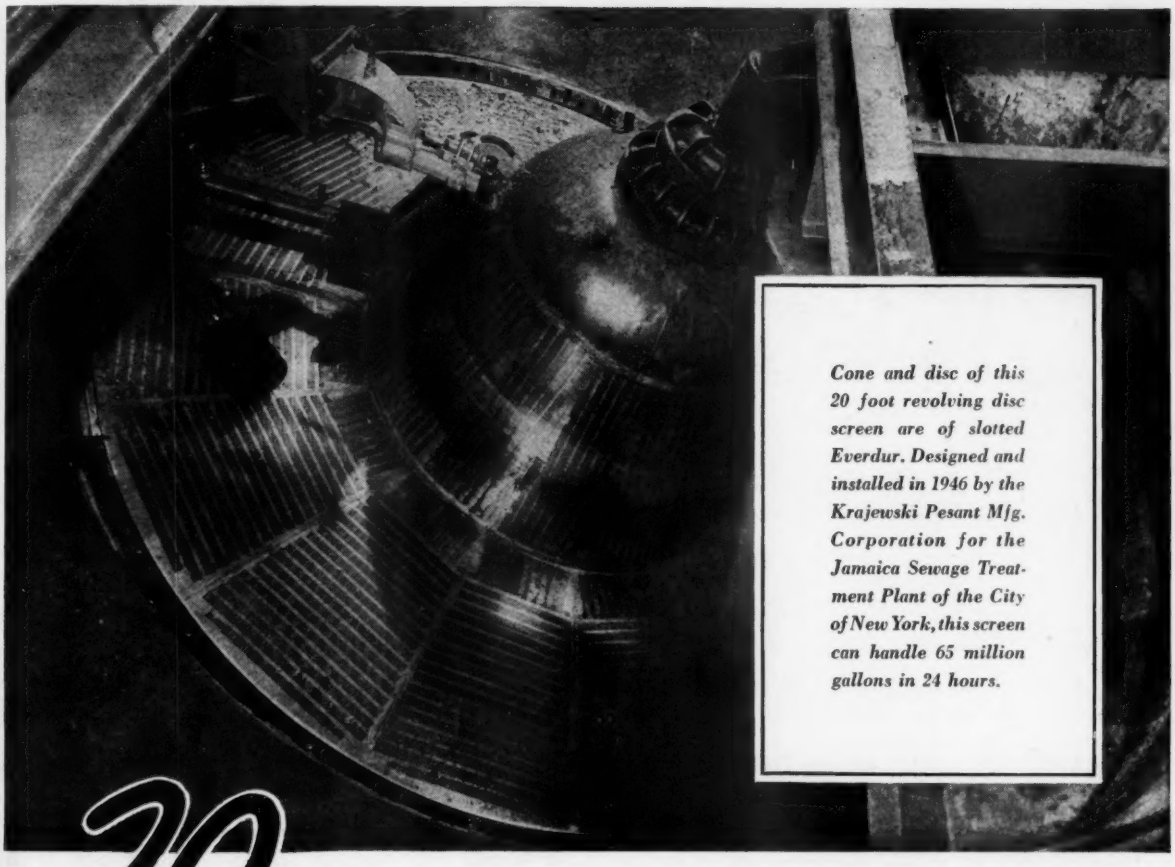

Cone and disc of this 20 foot revolving disc screen are of slotted Everdur. Designed and installed in 1946 by the Krajewski Pesant Mfg. Corporation for the Jamaica Sewage Treatment Plant of the City of New York, this screen can handle 65 million gallons in 24 hours.

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For detailed information write for Publications E-11 and E-5. 67197

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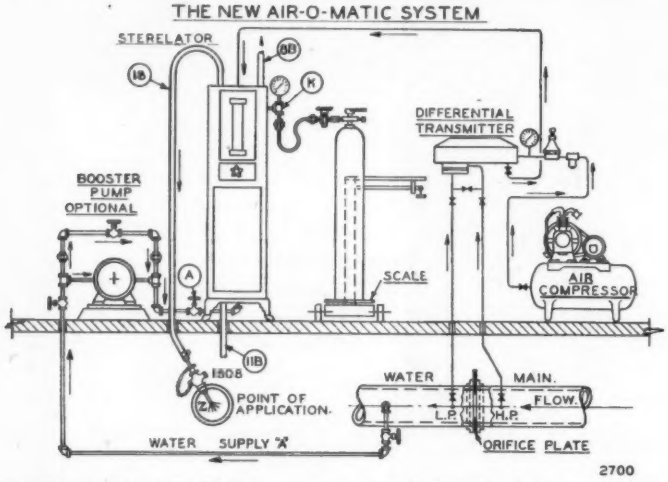

EVERSON STERELATORS are so designed that the basic unit remains unchanged, but by adding various controls can be adapted to perform added functions.

(A) MANUALLY CONTROLLED—The manually controlled, solution feed, vacuum type Sterelator is the basic unit and is used where constant feed at a fixed rate is satisfactory. The rate of feed can be adjusted through a range of 10 to 1, 50 to 1 or 110 to 1, by the use of the chlorine control valve with the selected model to cover the capacity range desired.

(B) SEMI-AUTOMATIC—By the addition of a solenoid operated water valve, the unit now becomes semi-automatic in its functions, starting and stopping with the pump whose pumpage is being chlorinated, always feeding chlorine gas at its set rate while operating.

(C) CYCLE CONTROL—By using electronic timing devices, the basic unit may be adapted to intermittent operation for definite and adjustable operating cycles.

(D) HYDRO-MATIC—By adding a venturi tube or orifice plate to convert the rate of flow into differential pressure, and with an EVERSON Hydro-Matic proportioner, the basic unit will then automatically proportion the flow of gas to the flow of water being treated within a range of 5 to 1.

(E) ELECTRO-MATIC—By adding a venturi tube or orifice plate to convert the rate of water flow into a differential pressure to a mercury well meter body which transmits the differential head measurements into a varying electrical resistance to a Robot containing electric controls, the basic unit will then automatically proportion the gas flow in direct proportion to the water flow within a range of 10 to 1.

(F) TOTALIZING AND RECORDING METERS—If desired Totalizing and/or Graphic recording meters can be placed in this same meter circuit and graphically record and/or integrate the water flow.

(G) AIR-O-MATIC—By adding a venturi tube or orifice plate and a pneumatic differential transmitter, the Sterelator unit will automatically proportion the gas flow in direct proportion to the water flow within a range of 10 to 1.

(H) ELECTRO-AIR REMOTE CONTROL—By adding a manual control sub-panel assembly for air operated remote control and timing devices for intermittent operation, the base unit can then be operated from the main control room of the sewage or filter plant.

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AUTOMATIC GAS STERELATOR

AUTOMATICALLY PROPORTIONS CHLORINE GAS TO FLOW OF LIQUID

RATIO 10 TO 1

VACUUM SOLUTION FEED USED FOR

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- **SEWAGE TREATMENT**
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The new Air-O-Matic system consists of THREE ESSENTIALS

1. The EVERSON STERELATOR with automatic air operated gas regulator and control valve.

2. Republic Pneumatic Differential Converter activated by fluid being treated.

3. Air Compressor.

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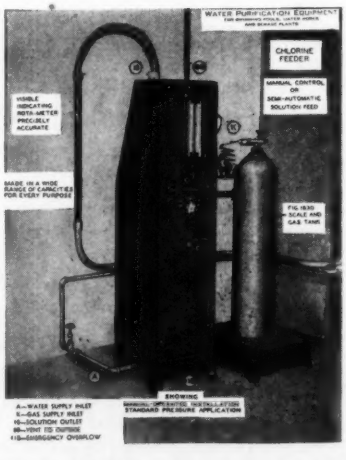

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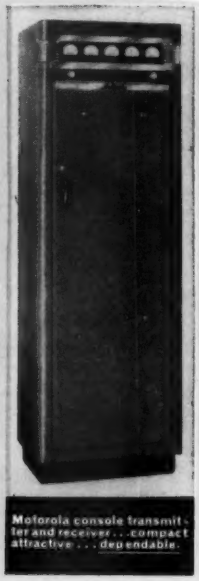

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1. Motorola-patented FM squelch system. The only system that permits full communications range with squelch control.
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THE AUTOMOBILE WAS A RICH MAN'S TOY

THE AUTOMOBILE WAS A RICH MAN'S TOY—but today nearly everyone drives a car.

An important reason for the rapid success and wide acceptance of the automobile is that it was designed and engineered for a single purpose . . . to provide better transportation.

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J-M engineers combined asbestos and cement under great pressure, produced a material that did a better job. The new material was called Transite. Transite is rustproof, it cannot tuberculate, it resists even the most corrosive soils.

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For all the facts about Transite, the *modern* water pipe, write Johns-Manville, Box 290, New York 16, New York.

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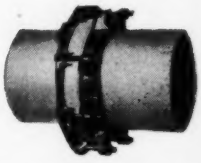
Water supply lines	Pumping stations	Sprinkler system piping
Distribution lines	Filtration plants	Sewer trunk lines
Intakes	Pump connections	Outfalls
Subaqueous lines	Penstocks	Force mains
Bridge crossings	Air conditioning piping	

● LATEST DRESSER CATALOG

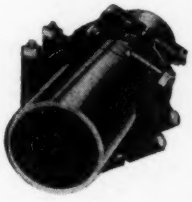
For detailed information on how Dresser products can simplify your pipe joining and repairing problems, write on your letterhead for a copy of the new No. 47 Dresser Catalog.

REPRESENTATIVE DRESSER PRODUCTS

Steel Couplings (Style 38) for joining plain-end steel and cast iron pipe. Sizes from ⅜" to 72" and up.



Adjustable Bell-Joint Clamps (Style 60) for repairing and preventing leaks in bell-and-spigot joints. Sizes 3" to 60" CIP.



"Adjustable" Repair Sleeves (Style 82) for quick, permanent repair on cast iron lines. Sizes 4" to 8".

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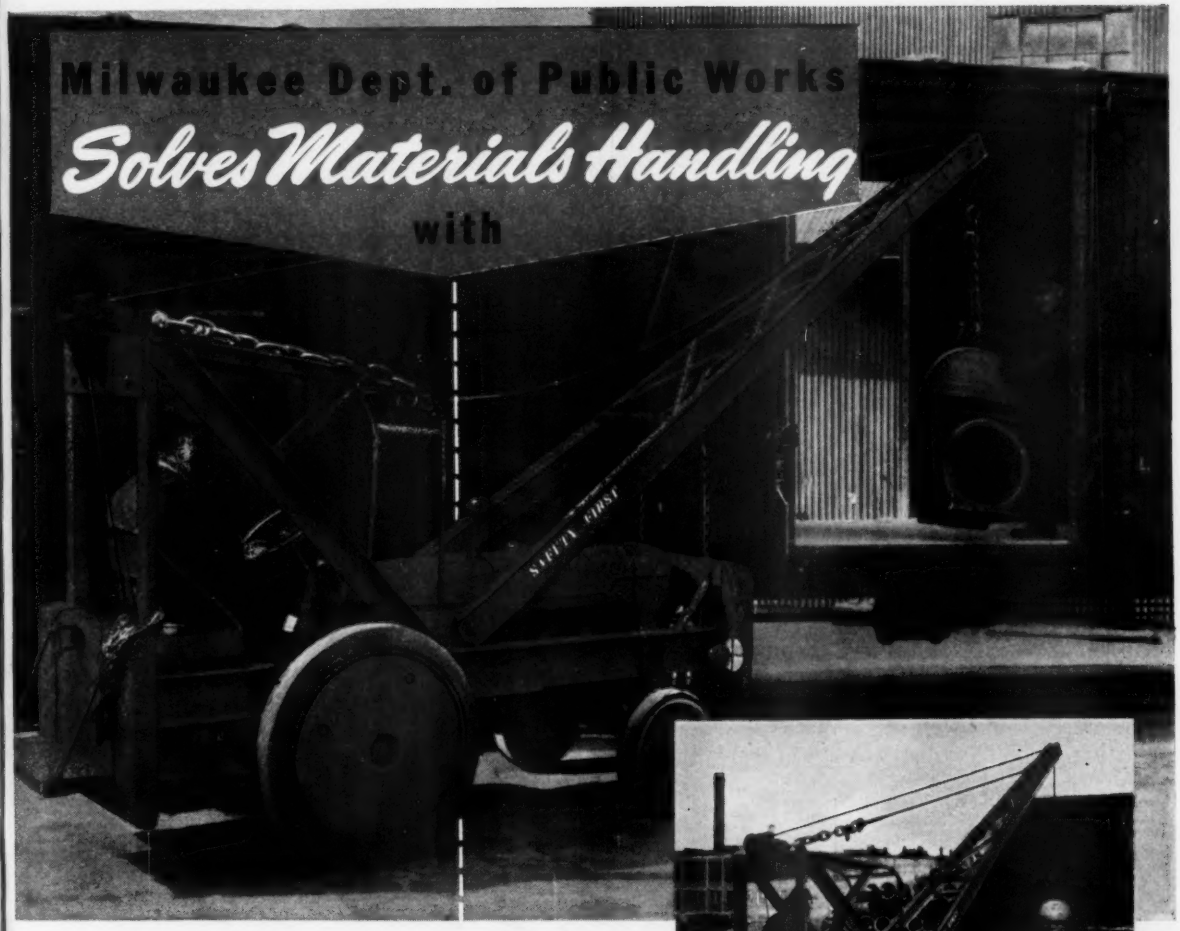

INTERNATIONAL
Industrial Wheel Tractors

Two International I-4 Tractors do the heavy lifting and materials handling around the Municipal Service Building in Milwaukee. One is shown in these views unloading and stockpiling a 16-in. gate valve weighing 1300 lbs. and a 12-ft. length of 24-in. pipe weighing 2400 lbs.

The crane-equipped tractors stockpiled everything in this water department yard. The department liked them because "they are faster and easier to handle than the cranes used before."

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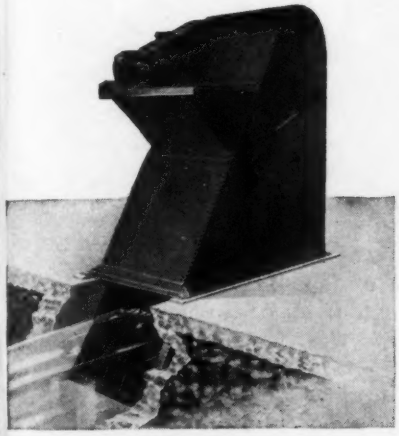
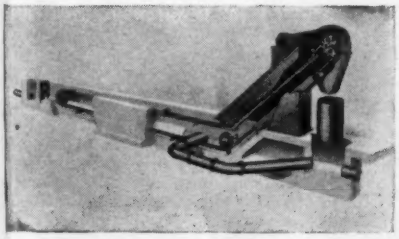
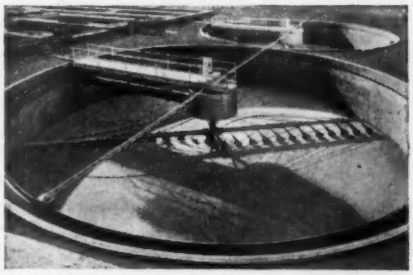


REX MECHANICALLY CLEANED BAR SCREENS are neat in appearance and provide an efficient means of removing large solids from liquids. They are easily installed in new or existing channels and have remarkably low head loss. With side frames recessed in channel walls, they assure an unobstructed flow to the rack.



REX TOW-BRO SLUDGE REMOVERS are the only sludge collectors which remove sludge from tank bottom immediately on contact instead of by the usual blowing or scraping. They assure accurate control of sludge removal over a wide range of withdrawal rates. Greater sludge concentration, greater operating flexibility and a clearer effluent are all readily obtainable with Tow-Bro.



REX FLASH MIXERS AND FLOCTROLS provide the necessary rapid dispersement of chemical throughout the liquid, followed by a gently multi-stage slow mixing for optimum floc formation. Floctrol designs assure utilization of full tank volume and important savings in chemicals.

REX CONVEYOR SLUDGE COLLECTORS combine the well-known advantages of the rectangular settling tank with a rugged and efficient form of sludge removal mechanism. Whether handling primary sludge or light flocculent solids, their performance is trouble free and dependable. They rarely need to operate more than a few hours daily.

REX GRIT EQUIPMENT, incorporating the exclusive principle of recirculation, effectively separates and removes inorganic solids from liquids. No grit washer is needed. Long life is assured with minimum maintenance.

REX SANITATION EQUIPMENT
Member of the Water and Sewage Works Manufacturers Association
CHAIN BELT COMPANY of Milwaukee

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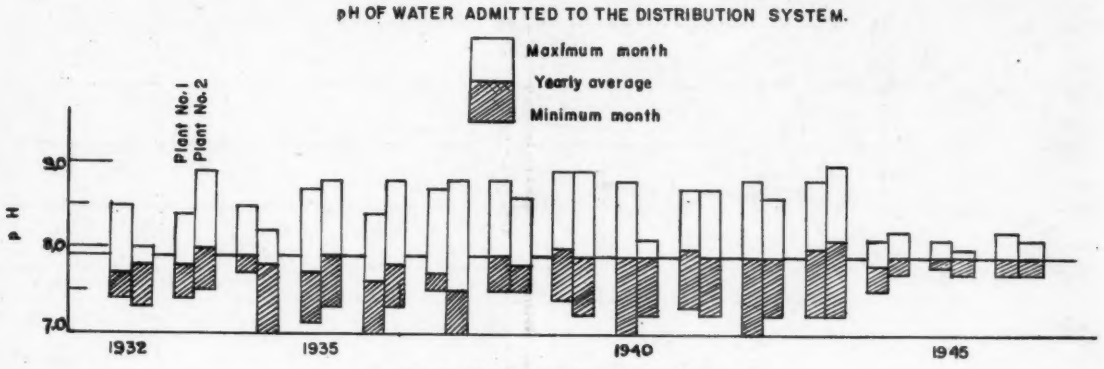


Fig. 2. pH of water leaving the plant.

Twenty-Five Years of Corrective Treatment for Corrosion

Results of use of lime to control aggressive carbon dioxide and prevent pipe line corrosion. Data on pH values throughout a large distribution system.

By EDW. S. HOPKINS

Associate Engineer, Bureau of Water Supply, Department of Public Works, Baltimore, Maryland

CORRECTIVE treatment with lime to remove "aggressive" carbon dioxide and retard *cold* water corrosion has been continuously practiced in Baltimore, Maryland, since 1922 (1). The practical value of this procedure has created the belief that the treatment *eliminates* corrosion, but the study by Hale (2) disclosed that corrision continued with alkali treatment in soft, slightly buffered waters, and that buffer action was of as great value in its control as artificially created alkalinity. Neutralization of aggressive carbon dioxide by alkali *checks* corrosion by the precipitation of a film of calcium carbonate on the internal walls of the pipe and is an indirect method of control.

A study of pipe corrosion in two large office buildings disclosed that the dissolved oxygen in the water decreased approximately 0.4 cc. per liter upon passage through their systems. The water was kept at the calcium carbonate equilibrium point. Corrosion was retarded in that "red water" was absent, indicating an immediate precipitation of the insoluble hydrous oxide and carbonates. The loss of oxygen, however, clearly indicated that hydrous ferric oxide formation was constantly occurring.

The Mechanism of Corrosion

Hot water corrosion is *not* checked by this treatment. As is easily demonstrated by chemical reactions, the free carbon dioxide is neutralized but the carbonate ion is unchanged. Upon heating, these ions break down to carbon dioxide and calcium hydroxide causing corrosion in *hot* water systems. This cannot be controlled at the water plant unless softening with lime is included as a component of the treatment process.

It is well recognized that in cold water corrosion iron dissolves, producing atomic hydrogen at a rate sufficient to keep a film on the surface of the metal. The rate of this corrosion is in proportion to the loss of the protective, passive, hydrogen film by reaction with the dissolved oxygen of the water or by conversion to molecular hydrogen (4). In neutral or alkaline waters, corrosion is governed by the action of the dissolved oxygen and in acid waters by the rapidity of molecular hydrogen production. It is apparent, therefore, that dissolved oxygen is the primary cause of most pipe corrosion. Systems showing a continual decrease in oxygen content, corrode in direct proportion to this loss. With bright or clean iron surfaces, pH values between 5.0 and 9.0 have little value in retarding corrosion by water. When rust is deposited in alkaline waters, corrosion will be checked; but if formed at pH values below the calcium carbonate equilibrium point, the coating will be porous, permitting diffusion of oxygen to the underlying metal. In addition to this deposition, iron is not very soluble in waters of high pH values, devoid of aggressive carbon dioxide. Therefore, if rust and an alkaline carbonate are precipitated on pipe surfaces, a more or less uniform, dense, compact, protective coating of hydrous ferric oxide and calicum carbonate will adhere to the metal. This coating will prevent diffusion of dissolved oxygen to the metal and also will insulate the corroding water from its surface. To control corrosion in water pipes, since oxygen cannot be removed, it is necessary to eliminate the factors causing a breakdown of the protective coating. Aggressive carbon dioxide is the most common factor found in natural waters that is capable of destroying this coating.

An inspection of an 8-ft. steel pipe line protected

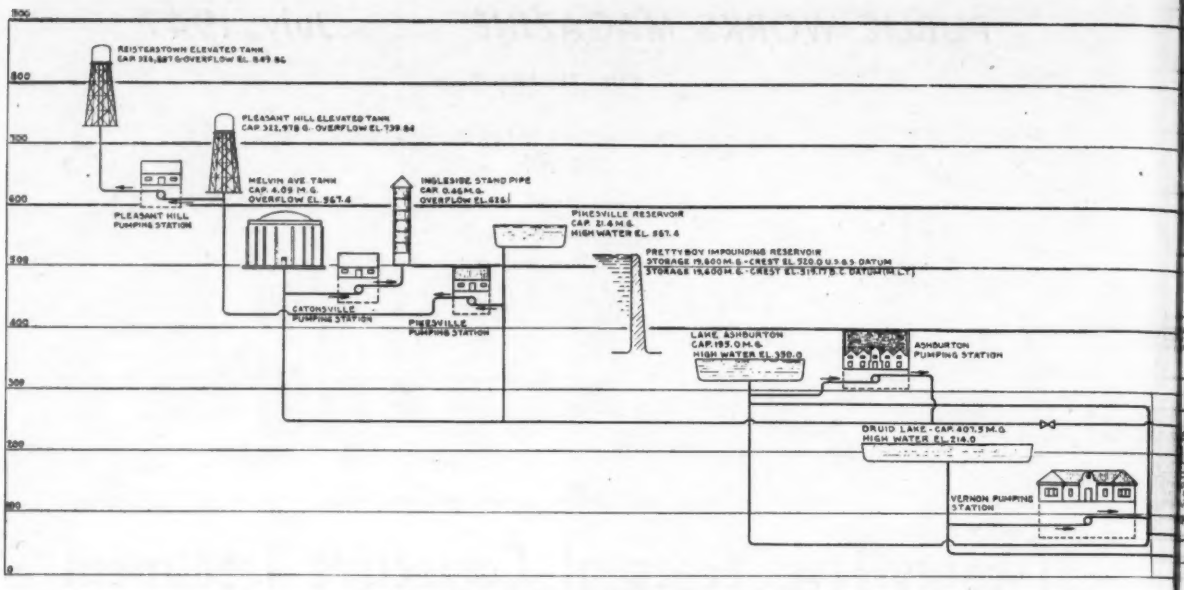


Fig. 1. Hydraulic diagram of the Baltimore water system.

with bitumastic paint, disclosed pits at sporadic intervals. This line had been in service for twenty-four years. It was noted that these pits occurred only at pin hole failures in the bitumastic coating. Some of them appeared to be in active condition while others were inactive. Upon analysis, it was found that the active pits did not contain precipitated calcium while those that were inactive did. It is of interest to note, however, that even the inactive pits did not possess a ratio of iron to calcium of 1 to 0.1 but only of 1 to 0.01. Insofar as this inspection was concerned, no factor was developed that mitigated against the older theories that *iron and calcium must be in a ratio of 1 to 0.1 in the precipitated coating if active corrosion is to be checked* (3).

Table 1.- pH Value of Water in Distribution System. Yearly Average of 41 Weekly Samples. Baltimore, Md.

	1st Zone	2nd Zone	3rd Zone	4th Zone	5th Zone
1931	7.8	7.8	7.7	...	...
1932	7.7	7.7	7.7	...	...
1933	7.7•	7.8	7.8	7.7	...
1934	7.8	7.8	7.9	7.8	...
1935	7.9	7.9	7.9	7.7	...
1936	7.8	7.9	7.8	7.8	...
1937	7.7	7.6	7.6	7.6	...
1938	7.8	7.8	7.8	7.7	...
1939	7.9	7.8	7.8	7.8	7.7
1940	7.8	7.8	7.8	7.8	7.6
1941	8.1	8.1	8.0	8.0	7.8
1942	7.9	7.9	7.8	7.7	7.6
1943	7.8	7.7	7.4	7.4	7.4
1944•	7.5	7.5	7.3	7.3	7.3
1945•	7.5	7.4	7.3	7.3	7.2
1946•	7.6	7.6	7.4	7.4	7.3
Max. Mo.	8.7	8.6	8.6	8.6	8.5
Av. Mo.	7.8	7.8	7.7	7.6	7.5
Min. Mo.	7.0	7.0	7.1	7.2	7.1

• Iron and lime discontinued, Sept. to Nov.

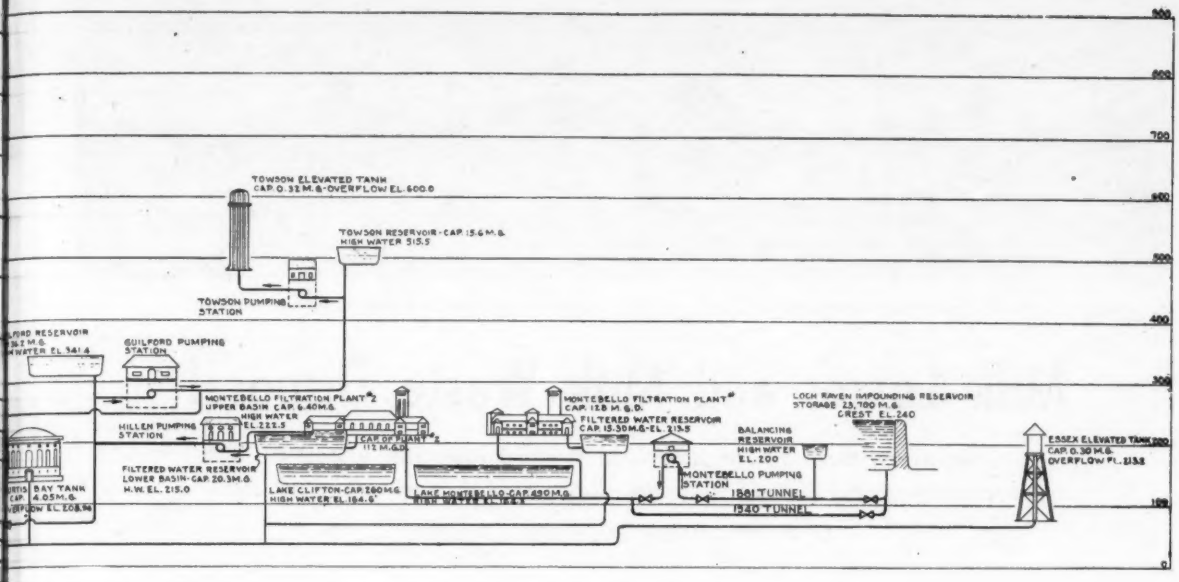
The value of corrective treatment with alkali rests upon the constant maintenance of the hydrogen ion concentration at the calcium carbonate equlibrium point. The decrease in pH values found in water at outlying portions of many distribution systems, excluding dead ends, is probably caused by an erratic lime application reducing the pH below the equilibrium point. Unless equilibrium is *constantly* maintained, all "aggressive" carbon dioxide will not be absorbed. The experience at Baltimore during the past twenty years justifies this conclusion.

The initial treatment in 1922 utilized a pH value of 8.3 to produce a slight "egg shell" precipitate of calcium carbonate in the distribution system, thereby forming a protective coating on the pipe. Changing buffer characteristics of the water, together with frequent testing by the von Heyer (5) marble test has made possible the continued maintenance of a coating with a pH value of 7.9 during the past sixteen years.

Distribution System and Sampling

Water from the two filtration plants is delivered to the distribution system by gravity and to areas at higher elevation than the plants by subsequent pumping and use of open balancing reservoirs. The system is divided into several service zones. The low service area below elevation 100 obtains its supply direct from the Montebello Filters and from Druid Lake which is directly interconnected to the plants. The second zone is between elevation 100 and 250. It is supplied by pumping from the low service zone into Lake Ashburton and Guilford Reservoir which serve as distribution reservoirs for this area. The third zone is between elevation 200 and 450. It is similarly supplied by pumping from the second zone into the Melvin Ave. tank and the Towson and Pikesville Reservoirs. Water from the third zone is pumped into the Catonsville, Towson, Pikesville and Reistertown tanks which maintain the supply in the fourth zone.

Forty-one samples are collected weekly from various points in the distribution system comprising all zones. The number collected is in proportion to the water usage and varies from two in the fifth zone to twelve in the first and second zones. Data reported



as indicative of the filter plant effluents are daily averages of samples collected every two hours.

Effect of Treatment

As illustrated by Table 1, the pH value of the water in the system has been consistent. It will be noted that the hydrogen ion concentration in the first and second zones is unchanged at pH 7.8. With passage of water through the second series of open reservoirs in the third zone some carbon dioxide is adsorbed, lowering the pH value to 7.7. This is below the calcium carbonate equilibrium point but is sufficient to prevent the dissolving of iron in appreciable quantity. In the fourth and fifth zones slight corrosion is continuing. With the water at pH values of 7.6 and 7.5 respectively, the rust coating deposited is porous. Soluble iron averages 0.25 ppm in the fourth zone and 0.40 ppm in the fifth zone as compared to 0.10 in the third zone and 0.05 in the first zone.

Fig. 2 showing the pH value of water leaving the filter plants indicates that prior to 1945 the maximum month and minimum month about equalized, with the average value close to the calcium carbonate equilibrium point of 7.9. It is significant that prior to 1944, due to the use of "iron and lime" treatment, the pH averaged 7.8 for nine months of each year and 8.3 the remaining three months. This is illustrated in Table 2. It is apparent from these data that the deposition of lime during the "iron and lime" treatment period, September to November, was of sufficient magnitude

Table 2.- 15-Year Monthly Average pH Value of Water in Distribution System

	Effluent Plant #1	Effluent Plant #2	1st Zone	2nd Zone	3rd Zone	4th Zone	5th Zone
January	7.7	7.8	7.6	7.6	7.5	7.5	7.4
February	7.7	7.9	7.6	7.6	7.5	7.5	7.5
March	7.8	7.8	7.7	7.7	7.6	7.5	7.5
April	7.8	7.7	7.7	7.6	7.6	7.6	7.5
May	7.8	7.7	7.7	7.7	7.6	7.6	7.5
June	7.7	7.7	7.7	7.7	7.6	7.6	7.5
July	7.7	7.7	7.7	7.7	7.6	7.6	7.4
August	7.7	7.8	7.7	7.8	7.6	7.7	7.5
September	8.1	8.1	8.0	8.0	7.8	7.8	7.5
October	8.4	8.5	8.2	8.2	8.0	8.0	7.8
November	8.2	8.2	8.1	8.0	7.9	7.9	7.6
December	7.6	7.7	7.6	7.6	7.6	7.6	7.5
Maximum month	8.9	8.9	8.7	8.6	8.6	8.6	8.5
Minimum month	7.0	6.9	7.0	7.0	7.1	7.2	7.1

Collections from same locations as Table 1.
Results from 5th Zone represent an 8-year average.

to retard corrosion sufficiently in the first and second zones even with passage of the water through the initial series of open reservoirs. In the third zone, after passage through the second reservoir series, corrosion was restricted while in the fourth and fifth zones the pH value was too low to precipitate a compact calcium carbonate film. Sufficient alkalinity was present, however, to prevent "red water" complaints. It will be noted that the pH value was above the calcium carbonate equilibrium point in the first three zones during the three month period of "iron and lime" treatment. In zones three and four, it persisted for about two months while in zone five, it was not effective at all.

Once equilibrium had been established in a given zone, conditions remained stable. The hydrogen ion concentration of the water at distant points in all zones equalled that of the water entering the zone or in the reservoir feeding it. The von Heyer (3) marble test was made on 76 tap samples collected from all zones between December 9, 1946, and March 20, 1947. Regardless of the zone from which obtained, the calcium carbonate equilibrium point varied from pH 7.8

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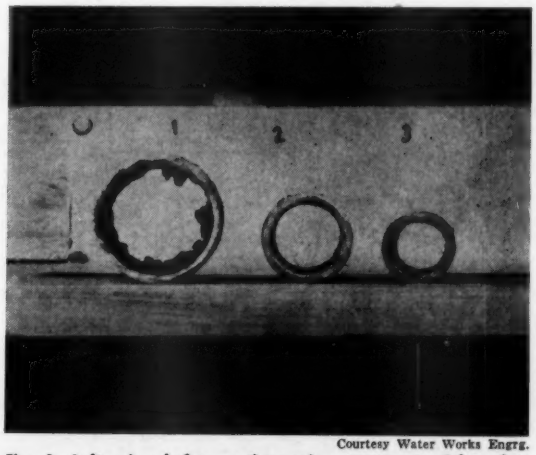

Courtesy Water Works Engrg.

Fig. 3. Left, pipe before anti-corrosion treatment; right, pipes protected by treatment.

Fig. 1. Plant under construction.

Fig. 2. A trickling filter installation.

Milk Losses and Milk Waste Disposal

Investigations that should be made toward reducing losses in milk processing plants in order to save money and reduce treatment costs.

By PHILIP S. DAVY and MELVIN J. NOTH
Davy Engineering Co., Consulting Engineers, La Crosse, Wis.

IN a number of municipalities where our firm has been employed to make plans for sewage treatment plants, milk processing plants constitute one of the major sources of waste requiring treatment. Investigations at a number of these plants, including measurement of the volume of flow and tests for BOD and Suspended Solids, have shown that there is a direct waste of milk and an excessive use of process water in most of them. The two plants cited below are typical of conditions that exist in many others, and they illustrate the direct money loss to the operator resulting from milk losses.

In a dry milk plant, a total of 375,000 pounds of milk was received daily, of which 340,000 pounds arrived in cans and 35,000 pounds in tank trucks. The total waste discharge from this plant amounted to 283,000 gals. per day, and the BOD of the waste was 1717 ppm., representing a total BOD load of 4049 pounds. One pound of BOD in milk wastes is the approximate equivalent of 10 pounds of milk; therefore, the 4049 pounds of BOD represents an equivalent loss from the milk plant of over 40,000 pounds of milk, since the domestic sewage load from this plant was negligible. At $2 per 100 pounds of milk, the loss amounts to about $800 per day.

In another plant producing butter and sweetened

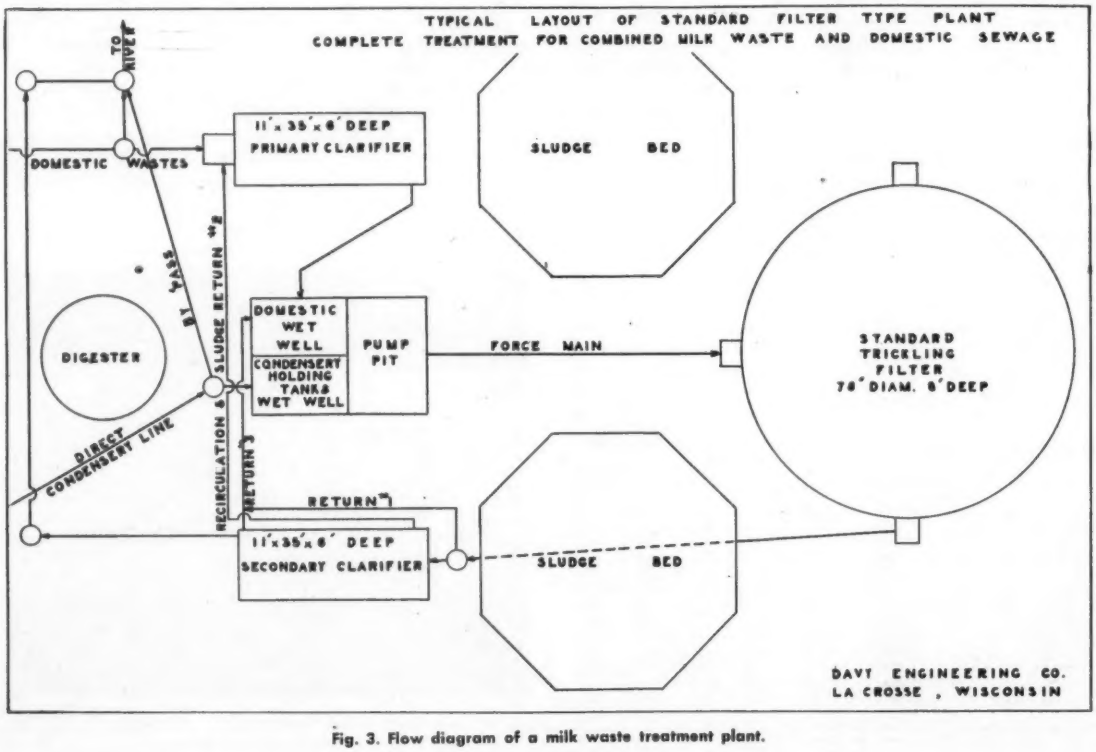

Fig. 3. Flow diagram of a milk waste treatment plant.

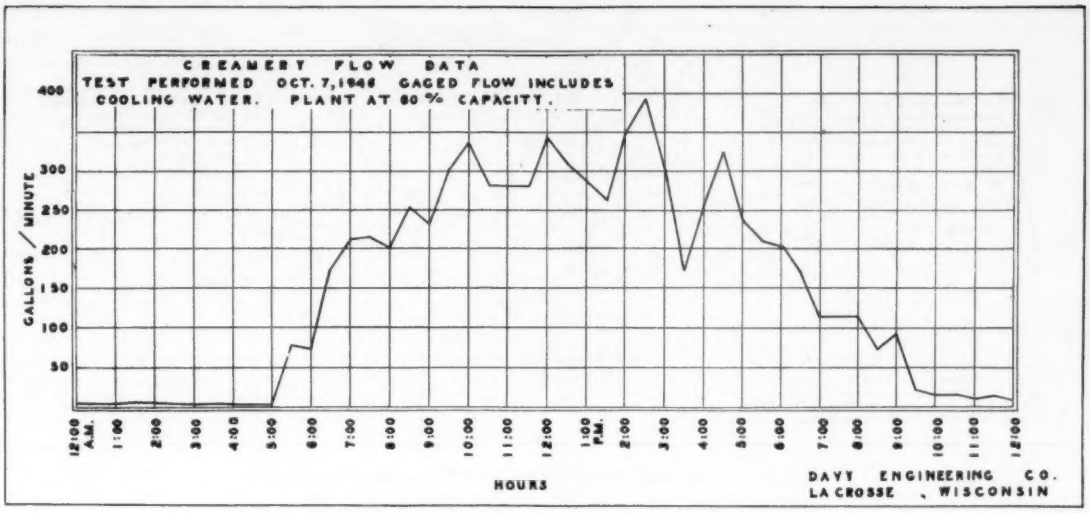

Fig. 4. Flow curve for butter and condensed milk plant.

condensed milk, 82,000 pounds of milk and 10,000 pounds of cream were handled daily. This plant had 220,000 gals. per day of waste, with a BOD content of 228 ppm., representing 528 pounds of BOD daily and indicating a loss equivalent to 5,280 pounds of milk, which at $2 per 100 pounds amounts to $105 per day.

In both of these plants, employees were aware that tests were being conducted and no large-scale dumping of milk occurred. Also, both plants were operating at only about 60% capacity at the time.

Not all of the losses of milk are preventable. Studies by L. F. Warrick, state sanitary engineer of Wisconsin, and others, have indicated that the normal loss of milk to the sewer should not exceed about 2% of the amount handled. The U. S. Public Health Service studies in the Ohio River area indicated the following to be reasonable losses: Dry milk plants, 0.6%; condensing plants, 1.6%; and creameries, 1.2%. Assuming a loss of 2% for each of the plants mentioned in this article, the avoidable daily loss at the dry milk plant is about 32,500 pounds of milk, valued at $650, and at the butter and condensed milk plant about 3400 pounds, valued at $68 per day.

Milk losses in a plant come mainly from two sources: One-fifth of the milk loss is milk that sticks to the can and is not weighed at all; in addition there are the general milk plant losses which are thoroughly discussed in Bulletin No. 2 of the Milk Industry Foundation. Investigations should be conducted at each plant to determine the proportion of losses due to each cause and corrective measures should be taken to minimize these losses. In one plant, losses were reduced 72% without making any equipment changes. Investigations should also be made to determine the possibilities of by-product utilization.

Reduction of avoidable losses saves money and also lowers the cost of waste treatment and decreases the difficulty of treatment. The money savings resulting from reduction of milk losses may repay, in a short time, the cost of the treatment of the remaining waste. In the case of the dry milk plant referred to, treatment by high rate filters including settling of filter effluent, separate sludge digestion, etc., would cost approximately $200,000 on the basis of the volume and BOD strength of the wastes now being discharged, whereas if the losses were reduced to a total of 2% or even 2½% of the milk received, treatment costs would be approximately $85,000.

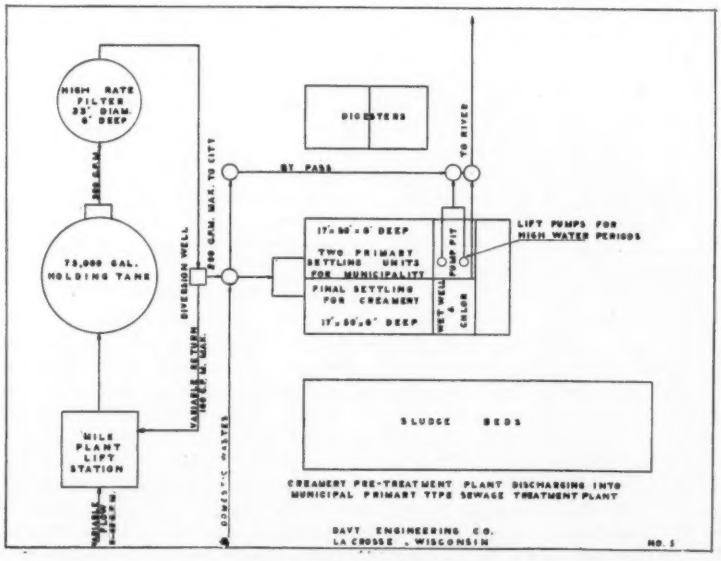

Fig. 5. Treatment plant layout.

A rough estimate of the cost of treatment can be based on the fact that, from a treatment point of view, each 1,000 pounds of milk that passes to the sewer is equivalent to the sewage from 600 people. In a plant where the daily milk loss is 10,000 pounds, the treatment problem is the same that it would be for a community of 6,000 people.

It should be kept in mind, however, that measurement of volume of waste and strength of waste from milk plants and direct conversion by computation to equivalent whole

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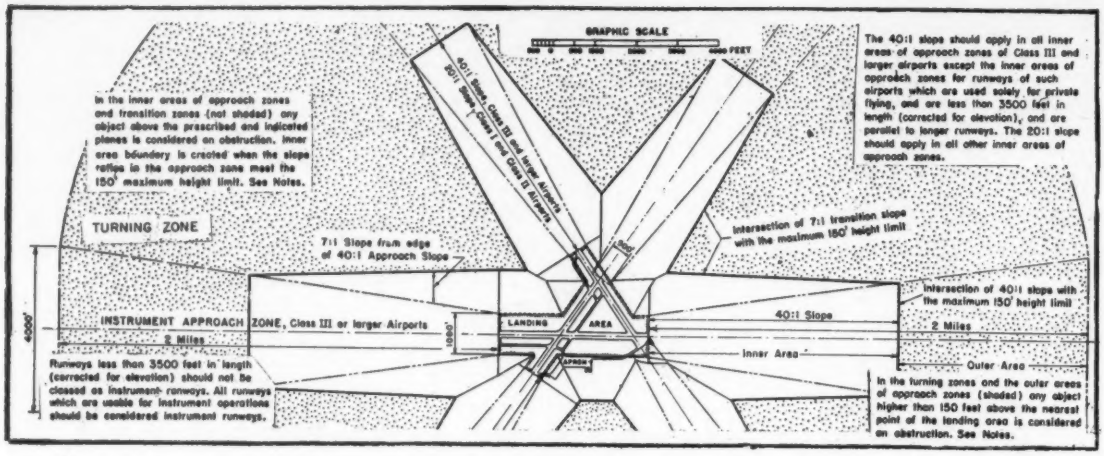

Fig. 1. Layout, airport approach standards, Civil Aeronautics Administration.

Protecting Your Airport Investment

A review of zoning regulations and procedures, with special reference to New York State, which may be followed to protect the airport against encroachment by obstacles to its full use.

By **JOSEPH C. FEDERICK**
Consulting Engineer, Albany, New York

AFTER detailed analysis has shown that a community needs an airport, the next task is to locate a site. This involves many engineering and economic considerations. The earning capacity of the airport is an item that should be given special consideration. This analysis should not be confined to income derived from aviation activities exclusively. It has been demonstrated that the proper planning of revenue producing facilities may double airport income. Consequently, the planning of these activities should be an integral part of the planning of the airport proper. In this connection what is of the highest importance is the relationship of the airport to the community and the surrounding region. The effect upon residential, business, industrial and other use areas shown on any city plan or zoning pattern must be appraised.

The Airport Should Create New Wealth

An airport should be instrumental in the creation of new wealth within the area it serves through the attraction of industry and trade; it must not be destructive of property values and other community assets. It should be protected against adverse influences that would render it inadequate for the function it is to serve. Of particular concern is the establishment of obstacles that would be a hazard to safe flight. Communities may utilize four methods to achieve the necessary protection. Municipalities may (1) make mutual agreements with the adjacent property owners; (2) purchase air rights; (3) purchase properties; and (4) exercise the police power through zoning. Aviation authorities are in general agreement that zoning is the most feasible method of achieving the desired objective. It has been believed that the grant of power under the usual state zoning enabling legislation, illustrated by the New York State law, which provides for the regulation and restriction of "the height, number of stories and size of buildings and other structures, the percentage of lot that may be occupied, the size of yards, courts and other open spaces, the density of population, and the location and use of buildings, structures and land for trade, industry, residences or other purposes" is broad enough to cover airport zoning due to the inclusion of the words "other purposes."

New York State, however, has recognized the importance of preserving the integrity of airports by enacting special legislation for this purpose. Any doubt as to the legality of airport zoning has been removed by amendments to the General Municipal Law which specifically provide for the protection of airport approaches. Municipalities have had the power to acquire the right to unobstructed use of the air space by means of purchase or condemnation. Under Sections 355 and 356 of the General Municipal Law additional power has been granted to prevent the establishment of obstacles to safe flight within a defined flight hazard area. It is declared to be the policy of the state to prevent such occurrences by utilizing the police power by zoning (1) by the state with the consent of the municipalities affected or (2) by the municipalities themselves.

Protecting the Airport

Any community having an airport hazard area, or any part thereof, within its boundaries is empowered by action of its governing body to adopt zoning regulations applicable, within the municipal limits, for the protection of the airport and its surrounding hazard area. However, in many instances airports are located beyond the boundaries of the owning municipality; in such circumstances the burden of enacting appropriate zoning regulations falls upon the municipality in which the airport is situated. The authorized procedure to be followed in such cases is the establishment of a joint airport zoning board by the affected municipali-

ties. Such boards, however, do not have any power to enact zoning regulations. Their function is to formulate the regulations applicable to the flight hazard area and to recommend their adoption by the municipality wherein the airport hazard is located. The charges incident to this procedure are to be borne by the requesting municipality unless some other mutually satisfactory arrangement is made.

Where a municipality in which a flight hazard area is located cannot agree with the owning municipality, the State Department of Commerce may be requested to provide the necessary protection. Any regulatory measures adopted by the Commissioner of Commerce must be preceded by an adequate notice and a hearing. The Commissioner of Commerce may designate an official of the municipality, within which the flight hazard area in question is located, to administer and enforce the adopted regulations. The costs of administration and enforcement are a charge on the requesting municipality.

A municipal airport represents a considerable investment of public funds. It also has a far-reaching influence upon the municipality in which it is located and the surrounding region. These are important reasons for cooperative preliminary planning of airports by all the municipalities affected irrespective of their geographical location.

Airport Zoning Provisions

The General Municipal Law contains what may be termed the airport zoning laws as distinguished from the general zoning laws. It is provided that in the event a municipality has already adopted a comprehensive zoning ordinance, or does so at some future time, any regulations pertaining to the airport and its flight hazard areas may be incorporated in and made a part of the zoning ordinance. The airport regulations may be administered and enforced in connection with the zoning ordinance by the municipality within which the regulations are applicable.

Of particular interest is the area in which such additional regulations are to be applied. The flight hazard area as given in the General Municipal Law is that portion of the air space including approach and turning zones, within three thousand feet of the airport, landing field or seaplane harbor. There are to be no interferences within this area with the ascent or the descent of any aircraft at a gliding angle of one foot in height to every seven feet of horizontal distance from the nearest point of the airport.

A clause in the law provides that the limiting distance may be greater, or other glide angles may be specified if the Civil Aeronautics Administration certifies that such greater distance and other angles are necessary for the approach and turning zones with respect to any particular airport. This requirement gives a certain amount of flexibility and provides for changing regulations.

The present standards of the Civil Aeronautics Administration are shown in the accompanying figures. Trees or structures which exceed the limits illustrated are considered obstructions.

Airport Hazard Areas

The airport hazard area may be divided into different districts or zones and within each such district or zone regulations may be applied which may differ as between different districts but must be uniform within districts of the same classification.

Under provisions of the General Municipal Law relating to the maintenance and operation of municipal airports, the local legislative body may, among other things, provide for the purchase and sale of aviation petroleum products, aircraft accessories and parts, and provide for the servicing and repairing of aircraft, and for all other services reasonably necessary or incidental to the operation of the airport. These permitted activities are of a business and industrial nature, which would characterize an airport as a business or industrial use and allow it as a matter of right in business or industrial use districts. Airports, however, are unusual in their requirements as to size and location, and must be treated accordingly. A procedure that may be followed in zoning for airports is to permit them in any district, subject to the approval of the Board of Appeals and to such conditions and safeguards as such Board may require to protect the rest of the community.

Studies will be necessary to determine the boundaries of the various districts into which the flight hazard

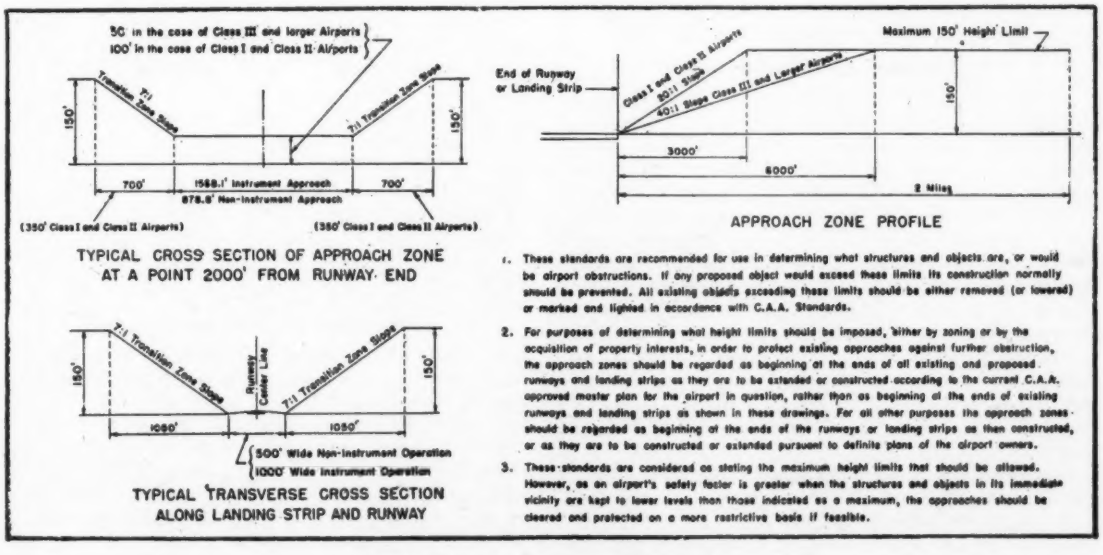

Fig. 2. Profile and sections, approach zone, CAA.

area is to be divided. One of the important considerations will be the topography of the area, and the relative elevation of the surrounding region to that of the airport. To determine maximum permissible heights, profiles should be prepared showing the configuration of the ground surface along lines drawn outward from the airport similar to those defining the approach and turning zones. The angles of elevation or applicable glide angles should also be shown. The vertical distance between the ground surface and glide line will give the maximum permissible height. The actual limiting height must be less than this dimension so that aircraft do not skim the housetops. In Westchester County, a model was prepared to show the structures that protruded above the safety ceiling. This is an excellent procedure to follow if it is possible to do so. From these studies, the boundaries of the districts in which certain height limitations are to be applied may be determined. Those districts that have the same maximum height limit will be given the same district designation.

It is suggested that the districts be termed "AH" or airport hazard districts. The district in which the height permitted is the most restrictive or the lowest will be designated as "AH-1 Districts." The numerical sequence will be from the most restrictive to the least restrictive "AH District." The district boundaries will be shown on the zoning map in a manner similar to the use districts, except that the type of boundary line employed will be such as to be readily distinguishable from other lines.

In the zoning ordinance, "AH" district regulations should be placed after the other district provisions as they may affect any or all of them. They are essentially height districts, as the uses permitted in such areas will have been determined in conjunction with the comprehensive zoning pattern of the community. The airport hazard districts are combining districts, *i.e.*, they are used in combination with other districts, the AH district plan being superimposed upon the general districting layout. It will also be possible for a single AH district, for example, the AH-1 district, to overlap several types of use districts, the additional height regulations being applicable to only a portion of such districts. This procedure does not violate the principle of uniformity within a district, as all buildings and other structures similarly located with respect to elevation or topography will be treated alike.

Regulations and Ordinances

Certain precautions are necessary when airport regulations are incorporated into a zoning ordinance. Although it is quite probable that the restrictions could be made a part of the zoning ordinance under the general zoning powers, it is well to cite any additional grant of authority. Consequently, any part of the ordinance that refers to the zoning powers under the state enabling legislation should also include reference to special legislation pertaining to the protection of the approaches to public airports. Reference to the above statutes may occur in the title of a zoning ordinance as illustrated by the Schenectady, N. Y., ordinance, as follows: "An ordinance establishing zoning regulations and providing for the administration and enforcement thereof, pursuant to the zoning provisions of the General City Law."

The General City Law contains the zoning enabling statute. With the establishment of airport hazard districts there would be added to the above at the end "and the General Municipal Law." This is the specific airport protection legislation. The districts also must be established by their inclusion under a section in the zoning ordinance titled "Establishment of Districts" and their boundaries must be shown on the zoning map. If there are any specific rules to be followed in interpreting the boundaries of the "AH" districts such rules will be included in a section on the interpretation of boundaries pertaining to the use districts.

Under the section "Application of Regulations" an item must be included applying to airport hazards similar to item 4 in the illustrative regulations which follow:

Application of Regulations. Except as hereinafter provided:
1. No building or land shall hereafter be used or occupied and no building or part thereof shall be erected, moved, or altered unless in conformity with the regulations herein specified for the district in which it is located.
2. No building shall hereafter be erected or altered
   a. To exceed the height;
   b. To accommodate or house a greater number of families;
   c. To occupy a greater percentage of lot area or
   d. To have narrower or small rear yards, front yards, side yards, inner or outer courts than is specified herein for the district in which such building is located.
3. No part of a yard or other open space required about any building for the purpose of complying with the provisions of this ordinance shall be included as a part of a yard or other open space similarly required for another building.
4. No structure, building, tower, pole, wire or other thing, or part thereof shall hereafter be erected, or trees or other natural objects be permitted to exist or grow to exceed the height that is specified herein for the airport hazard district in which such structures, object, or thing is located.

Model Airport Hazard District Regulations

Similarly, any other section of the zoning ordinance affected by the inclusion of airport regulations will have to be modified. A model airport hazard district regulation which may be used as a guide in preparing similar requirements for a specific situation follows. In this case the maximum height permitted is 90 ft., as determined by the appropriate studies. On the other hand, no building is to exceed the height limit specified in the use district with which the "AH" district is combined. For instance, if the AH-1 district is combined with an R-3 or multiple-family residence district in which the maximum permitted height is 60 ft., this height is controlling rather than 90 ft. insofar as buildings are concerned. Furthermore, the exceptions to height limitations contained in any supplementary regulations in the zoning ordinance will not be applicable to any airport hazard district. A certain leeway is allowed, however, by permitting any building or object to exceed the use district height limitations, if the supplementary regulations so provide, to the extent that the permitted height in the airport hazard district exceeds the allowable height in the use district with which it is combined. Taking the same R-3 district combined with an AH-1 district, let us assume that the supplementary regulations allow an increase in height in any multiple-family residence district of one foot for each foot that the front, side, and rear yards are increased beyond the required minimum. By leaving the additional open space, an owner might desire, and be able, to erect an apartment house say 100 ft. high. This is in excess of the 90 ft. prescribed in the AH-1 district regulations. Consequently, the building must be limited to 90 ft.

Like all zoning regulations the provisions relating to airports must be reasonable. Restrictions in the guise of zoning that are in reality a taking of the affected property will be declared invalid by the courts. Municipalities should guard against imposing regulations that prohibit or destroy the best utility of land sur-

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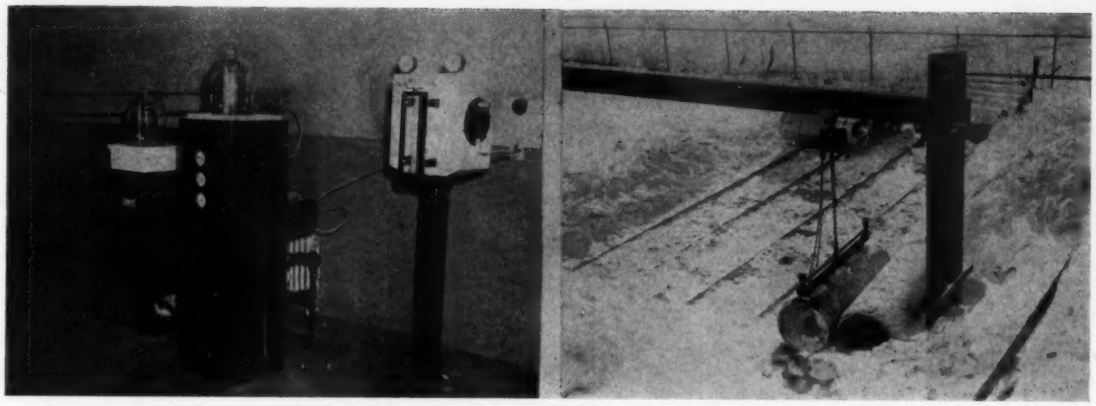


The chlorinator at left; at right, the container handling device.

Break-Point Chlorination at Plattsburg

How the plant was modernized and improved; and what happened when the chlorine dosage was really stepped up. Chemical costs were reduced, filter runs lengthened, and odor problems controlled.

By **FRANK D. BEHAN**
Plant Operator

THE original water system for Plattsburg, N. Y., was built in 1869; it was developed as a gravity supply, and has continued as such. The present normal sources of supply are West and Mead Brooks, each with about 7 square miles of water shed. The emergency supply is a 1 mgd. pumping station on the Saranac River. The water sheds of the brook supplies are thinly populated, resulting in a very little pollution. The river is subject to pollution and is known to receive sewage discharges but actual plate counts do not indicate heavy contamination at the intake.

On West Brook, two reservoirs are in use, both dams being of earth construction with concrete core walls. The first dam impounds 20 mg., the second 110 mg.; both reservoirs are shallow, averaging only 7′ to 8′ in depth, with marshy shore-lines. On Mead Brook an earth dam with a concrete core wall was constructed in 1923, creating 400 mg. storage. The average depth of this reservoir is 18′; the shore-line is clean.

The raw water is delivered to the plant from these reservoirs by two supply lines joining into a 20″ line at the plant. The emergency river supply is pumped over-ground 2,300′ and connects to both the supply mains. Chlorination is used at the pumping station, when operating, for the protection of the few consumers on the line between the pump and filter plant.

What the Treatment Plant Includes

The plant, constructed in 1936, is about 2½ miles west of the city. It consists of a mixing chamber, equipped with a revolving variable-speed mechanical agitator, and having a theoretical retention time of about 15 minutes; a covered around-the-end baffle chamber, retention 25 minutes; and covered settling basins, with retention of 3 hours. All retention periods are based on 4.15 mgd. There are six filters, capacity 4.15 mgd. at 2 gpm. per sq. ft. of filter area. Since the construction of the plant the filters have been rebuilt, using Anthrafilt to replace both gravel and sand. Anthrafilt #1 (E.S., 0.60-0.70mm. and U.C. of not over 1.60) is 24″ in depth. Supporting this medium are 11″ of #5, 3″ of #4, and 3″ of #3 Anthrafilt, making a total depth of 41″, leaving 25″ of free-board. Palmer agitators, two in each filter, were installed shortly after completion of the Anthrafilt installation. The agitators operate at 75# psi nozzle pressure and revolve at from 12 to 14 rpm. The filter control valves are manually operated, with direct acting operating rate controllers and loss of head gauges. The filter effluent goes directly into open concrete basins with a capacity of 5 mg. There is no conventional clear well and these filtered water basins act not only as clear wells but also as distribution reservoirs. A hydraulically controlled supply main valve maintains water level in the plant. At present one venturi on the supply main is the only record of flow. Directly over the mixing chamber are three dry feed chemical machines. Also on the second floor are two manually controlled vacuum type chlorinators of 100# and 200# capacity. At the pumping station is another chlorinator of 100# capacity. The plant laboratory is equipped to do routine physical and chemical analyses.

A New Operator Breaks In

As 1943 was my first year as operator, operating difficulties required considerable study and investigation to determine what steps should be undertaken to correct them. During 1944, sand was replaced with Anthrafilt, and the Palmer agitators were installed. Checking results of these various changes kept us pretty well occupied. So, it wasn't until the spring of 1945, that we got around to trying "break-point" chlorination. After numerous laboratory experiments, we began on plant scale, on April 21, 1945, to be exact.

It can be seen that in the case of the two shallow impounding reservoirs on West Brook, conditions were particularly favorable for the growth and development

Cost of Chemicals Used Per MG

	1943	1944	1945	1946
Alum	$3.81	$3.18	$2.76	$1.24
Lime	.447	.179	.183	.006
Carbon	1.728	1.849	.115	none
Ammonia	.20	.133	.037	none
Chlorine	1.457	1.363	2.425	1.744
All Chemicals	8.324	6.899	5.782	3.164

Operating Data and Water Characteristics

	1943	1944	1945	1946
Average Consumption, mgd	2.60	2.97	3.07	3.28
Filter Runs, hours	35.97	51.12	84.11	195.30
Wash Water, per cent	5.19	3.30	1.53	2.33
Total Cost, per mg	$26.44	$23.31	$21.03	$17.88
Chlorine dosage, ppm	2.39	2.25	4.00	4.25
Chlorine ppm, leaving plant	.40	.33	1.38	2.03
Chlorine ppm, entering system	....	....	.15	.16
Color, raw	17.0	17.9	21.8	17.6
Color, finished water	2.6	1.8	2.0	1.6
Hardness, ppm. delivered	85.4	106.5	89.3	85.9

of algae, with resultant taste and odor problems. Most troublesome were Anabaena, Dinobryon, Microcystis, and Asterionella; and on one occasion, in November, 1945, Cyclops moved in on us. A dose of from 4 to 5 ppm. of chlorine wouldn't touch them, but with 25 ppm. you could practically watch them keel over in a beaker. Copper sulphate was and is used to control growths in our impounding reservoirs, but even with this treatment, plus pre-chlorination and activated carbon treatment at the plant, we still suffered from taste and odor problems from early spring through the summer. The intensity of the odors usually decreased the latter part of September, only to increase again during November and continue through the early part of December, or later. Pre-chlorination in the mixing chamber, up to 1.92 ppm., followed by activated carbon in doses from 0.16 to 0.5 gpg., also applied into the mixing chamber, during taste and odor periods, never did give complete satisfaction.

Moving Into High Chlorine Dosages

Just prior to beginning break-point, we were treating 2.9 mgd. and pre-chlorinating at 1.7 ppm., with a residual on top of the filters of about 0.15 ppm. This residual was almost completely lost passing through the filters. Post-ammonia was fed into the effluent line at the rate of 0.05 ppm., followed by post-chlorination at the rate of 0.25 ppm. This treatment gave an average combined residual of 0.25 ppm. which was much more stable in the open filtered water basins than our present free residual chlorine. At the time the average apparent color of the water was 33.4 ppm. in the raw and 3.2 ppm. in the finished. Turbidity was 3.3 on raw and a trace on finished. We were feeding 1.98 gpg. of activated alum and 0.68 gpg. of post-lime, for pH control. The pH on the raw averaged 7.38, on the settled 6.37 and on the finished 7.0. Raw water had an odor of 2 earthy, with 1 earthy on the finished. Hardness, (soap) was 84 ppm. The accompanying table gives some water characteristics.

With the advent of break-point, we discontinued the use of both post-ammonia and post-chlorination. Having always used pre-chlorination we didn't have to worry much about the filters unloading when these high residuals began to pass through them. During May 1945, the pre-chlorination dose went up to 3.82 ppm. with from 1.25 to 1.5 ppm. on the filters. In the finished water, free residual chlorine averaged 1.0 ppm., both alum and lime dosages remaining about the same as in April. It is of passing interest to note that post-lime for pH control, in conjunction with high chlorine dosages didn't cause any medicinal or iodoform taste or odor, as has been reported in some instances.

The Odor Problem Becomes Fishy

After May 1945, odors became more intense on the raw supply, changing from 2 earthy to 2 and 3 grassy, then for a couple of days to 3 moldy, back to 3 earthy, with some fishy odor thrown in, and finally after treating impounding reservoirs with copper sulphate at the rate of 2# per mg., odor on the raw dropped down to 2 earthy.

This earthy odor has been reported as hard to remove with break-point, but we have not had a trace of this odor at any time on the delivered water. Free residual chlorine was 0.1 ppm. leaving the open filtered water basins to the distribution system. During June 1945, we maintained about the same rate of feed but found it very difficult to hold a residual in the open filtered water basins. We were not too anxious to get a free residual into the distribution system during the warm months when the temperature of the water would increase the intensity of any odors developed from the first stages of treatment. The finished water leaving the plant had a 3 chlorinous odor but no taste; and this odor completely disappears in the open filtered water basins.

During the fall months of 1945, as the temperature of the water began to lower we started to push the free chlorine residual into the distribution system at from 0.5 to 0.8 ppm., an amount unheard of previously. Complaints began at points nearest the plant and continued to fan out to the extreme ends of the system. Many times the reports came to us at second or third-hand but we finally got to most of the original complainants. It was our intent to investigate each and every complaint. In every case the claim was "a very strong odor and taste of chlorine." Actually, the odor was decidedly strong chlorinous while the taste was negligible. An OT test was made in the presence of the consumer and without exception, there was not a sign of residual. It was explained that this taste or odor was not the chlorine itself, but rather a combination of free chlorine acting on substances in the mains. We asked them to bear with us through this period of chlorinous tastes and odors and assured them that, as soon as we could find traces of chlorine, the odors would be gone. (We hoped). This is what really happened and as soon as we could be sure that a residual was present, we returned to show them that, although the odor was gone, the chlorine was there.. The period of concentrated complaints lasted approximately 6 months. The only complaint that we now get is an occasional report concerning chlorinous odor the first thing in the morning from hot water taps.

It might have been possible to have reduced the length of this complaint period by flushing mains but flushing might have caused dirty water, even more objectionable to the consumers than the chlorine odors. During the transition we were not troubled with rapid disintegration of pipe line deposits. Only at extreme dead ends did color increase and then only 2 or 3 ppm.

An Unexpected Dividend

An unexpected dividend was received from the change to high pre-chlorine doses. The raw water has little natural turbidity and the alum used is planned to give as low a color as possible in the fin-

(Continued on page 62)

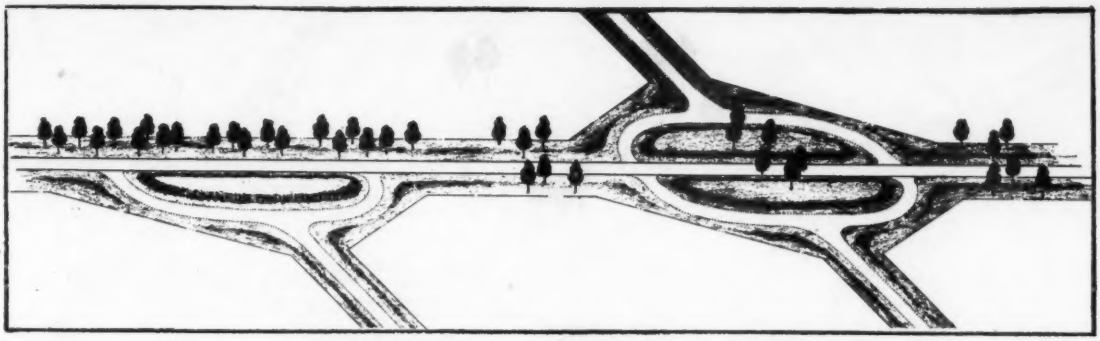


Fig. 1. Safe layout for a crossing and for an intersection.

Building Safety Into Low Cost Road Junctions and Crossings

Layouts that are simple to construct, not costly, and permit cross-road intersections at grade, while controlling entrance speeds and preventing indiscriminate turning movements.

CLOVER-LEAF intersections and other costly devices for separation of traffic at intersections are not available for the average rural road, whether county or city. However, the need for safety is just as great, considering the relative volumes of traffic. Herewith are shown a number of methods of reducing traffic hazards on rural road intersections. These are taken from publications of the Texas Highway Department, Landscape Division, of which Jac L. Gubbels is in charge. These publications include the following: "Illustrated Studies of Controlled Access Highways" and "Suggestions for Roadside Development."

The controlled access features shown in these illustrations should not be confused with "expressway" features. Expressways permit free and continuous movement of all vehicles; they allow no stop signs, no left turns, and no cross intersecting roads without an underpass or overpass. They deny access to the road except at points where a clover-leaf or other traffic interchange is provided. Controlled access highways, on the other hand, provide a reasonably continuous flow of traffic, but permit road intersections at grade and direct access at any point. Indiscriminate turning movements are controlled by low retaining walls, traffic island, and similar simple devices.

Fig. 1 shows two layouts, one for a crossing and one for an intersection or junction. The island areas shown, whether for junction or crossing, should be graded to a height of 18 inches to 24 inches above the pavement. The planting shown helps make the circle or half-circle more visible and tends to reduce accidents. The radius of the circle at the crossing, or of the half-circle at the junction, should be at least 100 ft.

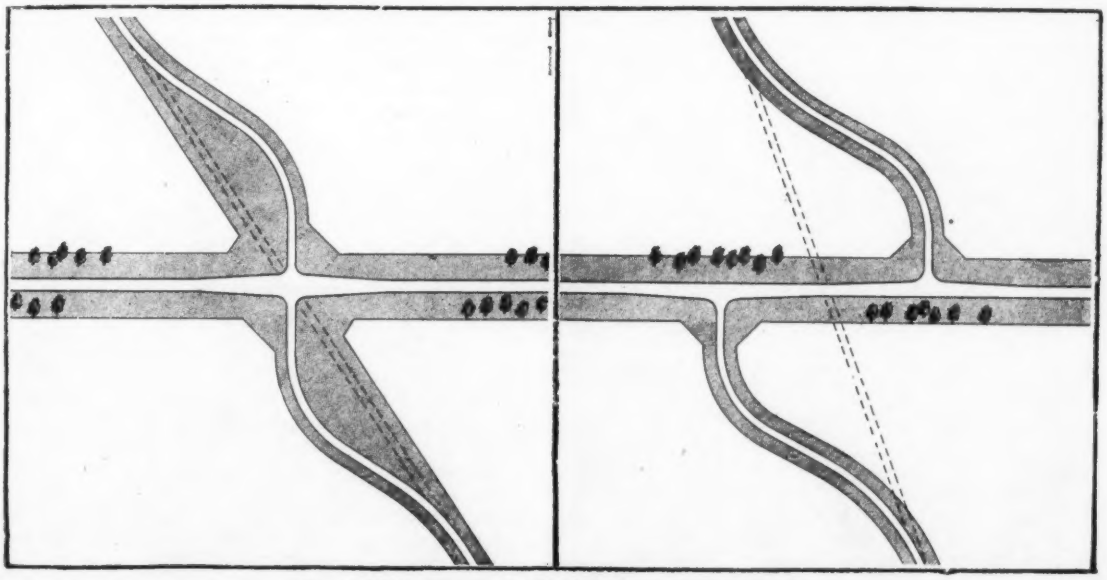


Fig. 2. Safety measures simpler than those shown in Fig. 1.

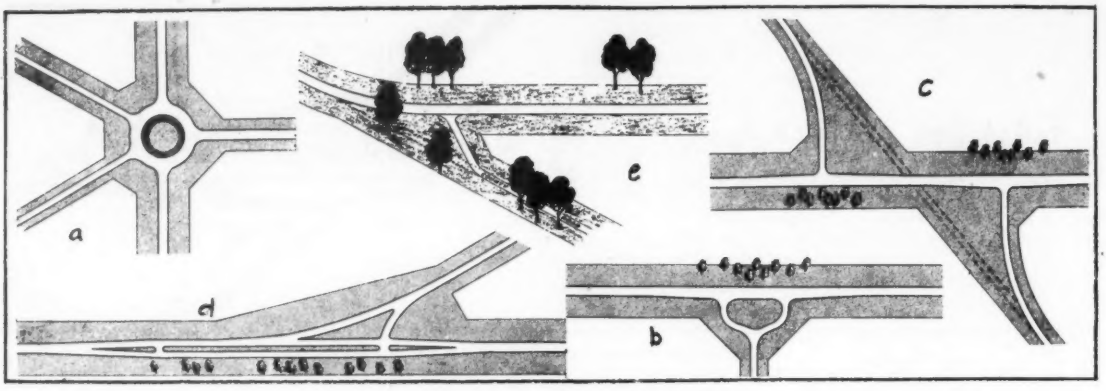
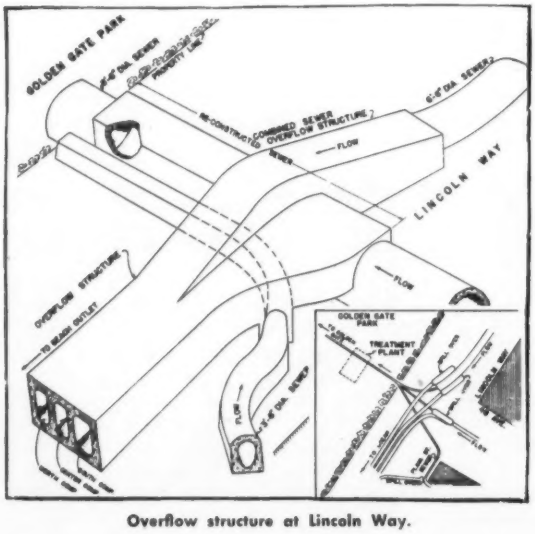


Fig. 3. More ideas for safe rural intersections.

Fig. 2 shows two methods of reducing the hazards at crossings, which do not involve quite as much work as the methods shown in Fig. 1, especially where topographical conditions are favorable. These methods are based on bringing the vehicle traveling on the minor road to a controllable speed, which is accomplished by inserting curves in the approach, starting with a moderate curve and increasing it to one of smaller radius. In the illustration at the left, a diagonal road has been relocated to give a right angle intersection, but safety has been increased by the insertion of visible curves in the secondary road, so that oncoming cars will slow down before reaching the intersection. Proper planting on the outside of the curve will add to safety. In the illustration on the right, the same type of diagonal intersection has been treated in a different manner. Not only have reverse curves been inserted, but the crossing is staggered so that cars approaching the intersection on the secondary road must slow down very materially to make the turn into the main road, regardless of whether they continue on the secondary or the main road. In general, the minor roads should enter the main road at a considerable distance apart, 1,000 ft. being preferred. Appropriate planting should be placed on the far side of the main road opposite each of the junctions, and planting is also desirable on the outside of the curves where the minor road approaches the main highway.

In Fig. 3 are shown a number of variations of the above plans, as well as other devices of value in increasing safety. Illustration *a* shows a simple type of traffic circle that can be used where several roads come together, as the familiar "five points" often found in rural areas. Another variation of the layout shown in Fig. 1 is illustrated by *b*, while *c* is a variation of the plan shown at the right in Fig. 2, but is somewhat simpler, the curvature being reduced, but the staggered intersection retained. This may be used where topographical conditions favor it. Channelization to reduce the hazard of accident at an acute angle junction is shown in *d*. A suggested layout to reduce the hazard where a minor road enters a major road on a curve, at an acute angle, and against traffic, is shown in *e*. By inserting a bend and providing a right angle (or nearly a right angle) junction, vehicles entering the main road from the minor road are forced to slow down.



Overflow structure at Lincoln Way.

Storm Drain Design and Construction in San Francisco

The Lincoln Way storm drain, designed to relieve the overload on the Mile Rock Tunnel and prevent the annual flooding of the La Playa district of San Francisco, was completed last year. This sewer, consisting of three compartments, each 6 ft. by 6 ft., terminates in an outlet structure protected against debris by a heavy pipe grill and sealed by timber swing gates to prevent the escape of odors or the entry of sand from the beach. A 6-inch pipe and hydrant furnish water for sluicing away accumulations of sand against the gates which might delay their opening. Special outlet pipes through the gates insure the saturation and removal of sand obstructing them. The overflow structure is comparable in size and complexity to a subway station, as is illustrated by the accompanying drawing.

Synthetic Rubber Particles Make Street Slippery

In San Francisco, a smooth brick pavement on a steep grade became so slippery, due to small particles of synthetic rubber from automobile tires, that whenever a light rain or drizzle occurred, it was necessary to sand the pavement until the drizzle stopped or until a heavy rain flushed off the surface. As a preventive, the surface was coated with small stone and a high viscosity emulsified asphalt, but due to the steep slope and the tendency of the coating to roll, this did not prove satisfactory. Removal of the pavement is now contemplated.

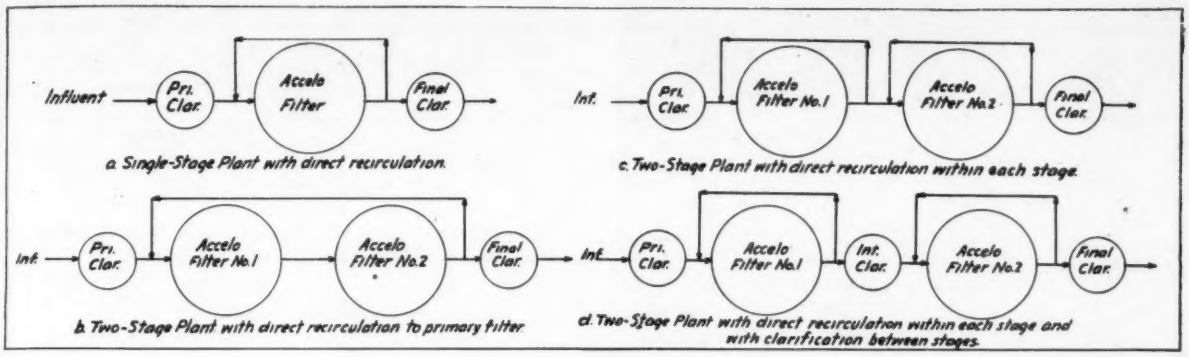


Fig. 1. Flow diagrams for single and two-stage combinations.

TRICKLING FILTERS

The Accelo-Filter: Description—factors in treatment—bases of design—BOD loadings—media and ventilation—typical plant layout.

This article was prepared by H. W. Gillard of Infilco, Inc., and coordinated by the editors of Public Works Magazine and consultant staff.

THE Accelo-Filter system involves the direct recirculation of unsettled effluent from a biological filter back to the inlet of the filter distributor. This principle may be used with either low-rate or high-rate filters. Where the sewage plant effluent must be well nitrified with a low biochemical oxygen demand, a low-rate filter with direct recirculation is preferable.

The direct return of filter effluent containing active aerobic organisms, produces intensified biological oxidation. Just as in a chemical reaction, the law of mass action applies to a biological reaction. This is the logical principle involved in the use of the Accelo-Filter system, which is a patented process.

Treatment Factors

Knowledge of the actual mechanics of any biological oxidation process as it occurs in a trickling filter leads to the conclusion that the following factors are essential to optimum treatment results:

(1) Establishment and maintenance of a healthy, active biological growth on the filter media.
(2) Adequate available oxygen, which calls for good ventilation.
(3) Time of contact, of the sewage being treated, with the bacterial film.
(4) Temperature within the filter.

It will be appreciated that if factors 2 and 4 listed above are ideal for proper filter operation, direct recirculation of filter effluent will provide added assurance of an active bacterial growth and will increase the time of contact. Since none of the other factors will be greatly influenced by such recirculation, biological oxidation must necessarily be increased by the combined benefit derived from items 1 and 3. Whether or not these theories are controlling, the facts are that the end results have been proved by actual operating installations, as shown by operating results, some of which are given later in this article.

The intensified biological oxidation, with adequate provision for the other factors mentioned above, is perhaps a prime reason why filter clogging is not experienced at any Accelo-Filter plants in service. This has been true also of low-rate filters continuously dosed at rates of 3 to 6 million gallons per acre per day. The flushing action at these low rates can hardly be credited with the elimination of clogging and ponding, although it must be conceded that the increased flow through the filter, due to direct recirculation, does assist to some degree and may be a controlling factor with high-rate filters. Data from Accelo-Filters operated at high hydraulic loading rates (10 to 30 mgad.) demonstrate the high efficiency in terms of 5-day BOD removal per unit volume of filter media.

Bases of Design

In the design of either a high-rate or low-rate Accelo-Filter plant, both primary and final clarifiers should be selected on the basis of the flow in accordance with requirements of the Sani-

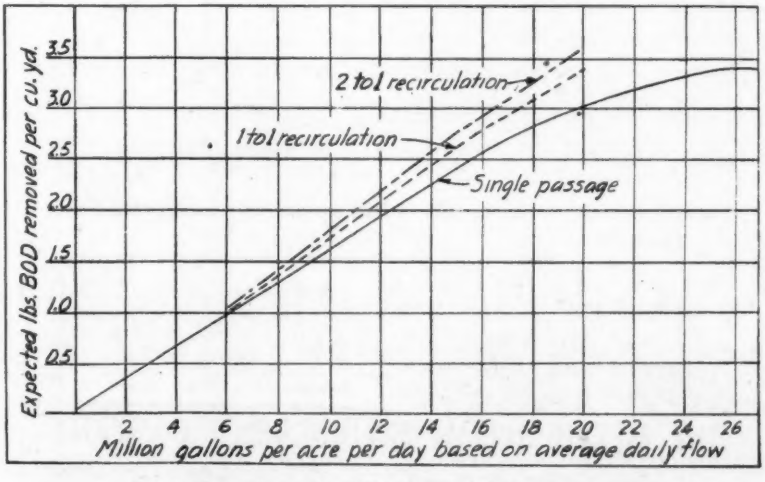


Fig. 2. Expected pounds of BOD removed for various flows.

tary Engineering Division of the State Department of Public Health. In any case the sedimentation tanks should have a detention time of 2 to 2½ hours and an overflow rate not in excess of 800 gallons per square foot of tank surface area per day based on the average inflow of sewage into the clarifier.

To determine the organic loading to the filter it is reasonable to expect 30% to 35% reduction of biochemical oxygen demand through the primary sedimentation tank. Having determined the organic load to be handled and knowing the flow rate, a selection of the type of Accelo-Filter system should be made with due consideration to final effluent requirements, i.e., high-rate, low-rate, two-stage high-rate, or one-stage high-rate and second-stage low-rate. Flow diagrams are shown in Figure 1. Figs. 2 and 3 were plotted from average results obtained with both low-rate and high-rate filters of all types. Consequently, these may be safely used as a basis of filter design.

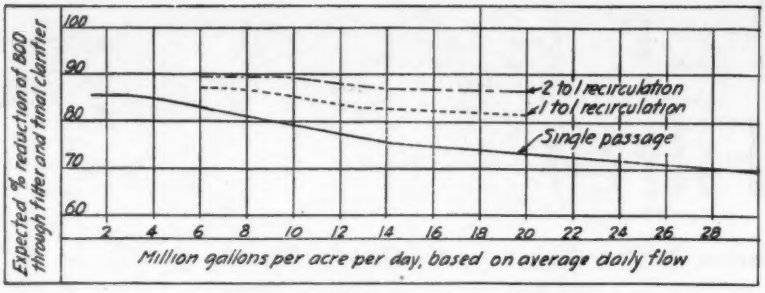


Fig. 3. Expected per cent of BOD removed.

BOD Unit Loadings

For the treatment of normal domestic sewage a loading of about 1.5 lbs. of BOD per cubic yard of filter media, which is equivalent to 2,420 lbs. per acre-foot per day, may be used for single-stage high-rate filters in the northern states; and a loading of about 1.87 lbs. per cubic yard per day, or 3000 lbs. per acre-foot per day, in southern states. A maximum hydraulic loading of about 30 mgad, including recirculation, should be used. It will be noted that these design loadings will come within the requirements of the Upper Mississippi Valley joint statement of policy for the high-rate filter.

If the receiving stream characteristics indicate the need of a well nitrified plant effluent, a low-rate filter loading rate of 400 to 600 pounds of BOD per acre-foot (0.25 to 0.37 lbs. per cubic yard) of filter media per day should be used; and on this basis the hydraulic loading will seldom exceed 6 mgad. Some results of low-rate filter operation are shown herewith.

Operating Results

The Fort Jackson, S. C., single-stage plant reports for 1944 show an average loading of 1.85 lbs. of BOD per cu. yd. per day, varying from 1.28 lbs. in February to 2.13 lbs. in April. The filter effluent was recirculated to the filter at an average ratio of 1.42 to 1, varying from 1.04 to 1.82. The overall removal of BOD averaged 81%, varying from 74% in January to 87% in September. Removal by filter and final clarifier averaged 73%, varying from 65% in January to 79% in September and November. Average BOD of raw sewage was 347 ppm.

Results are also given for the operation of a single-stage filter for the

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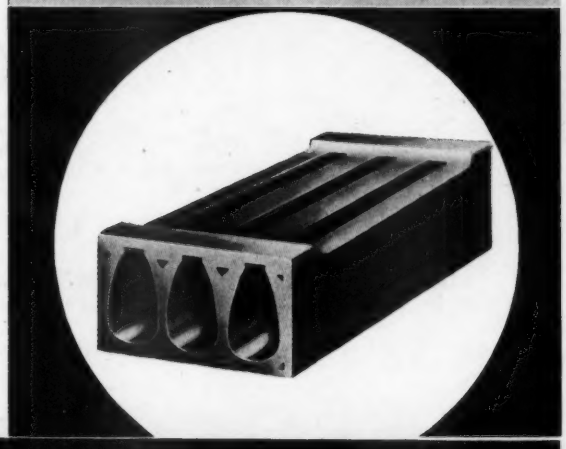

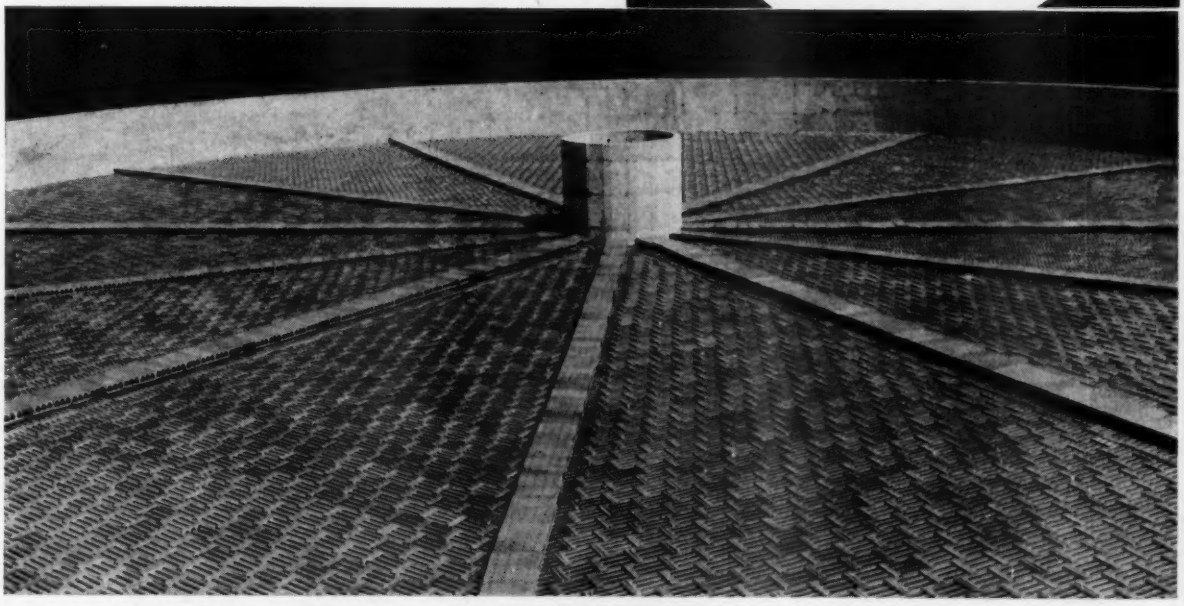

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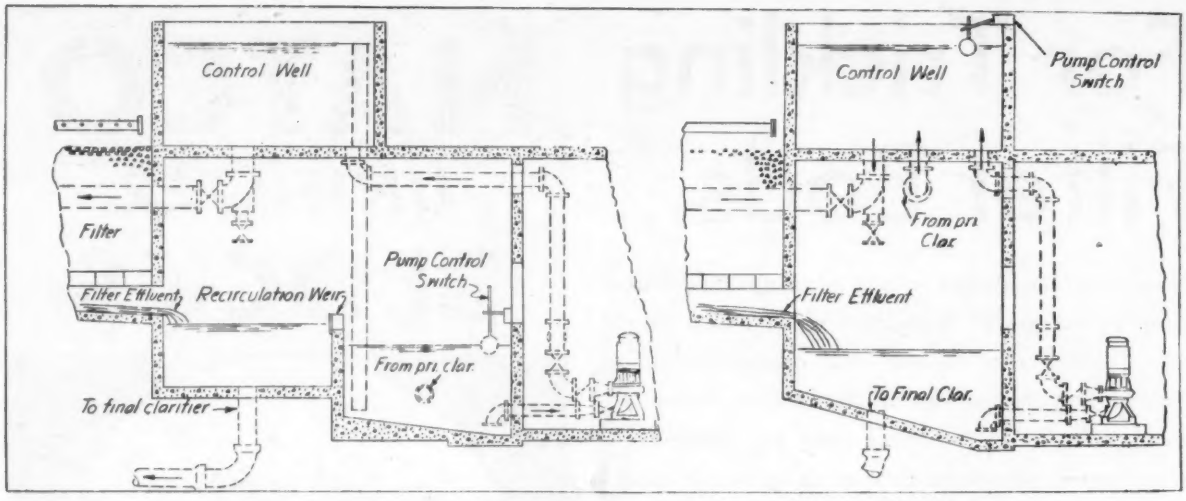


Fig. 4. Pumping arrangements: Left, where sewage must be pumped; right, for recirculation.

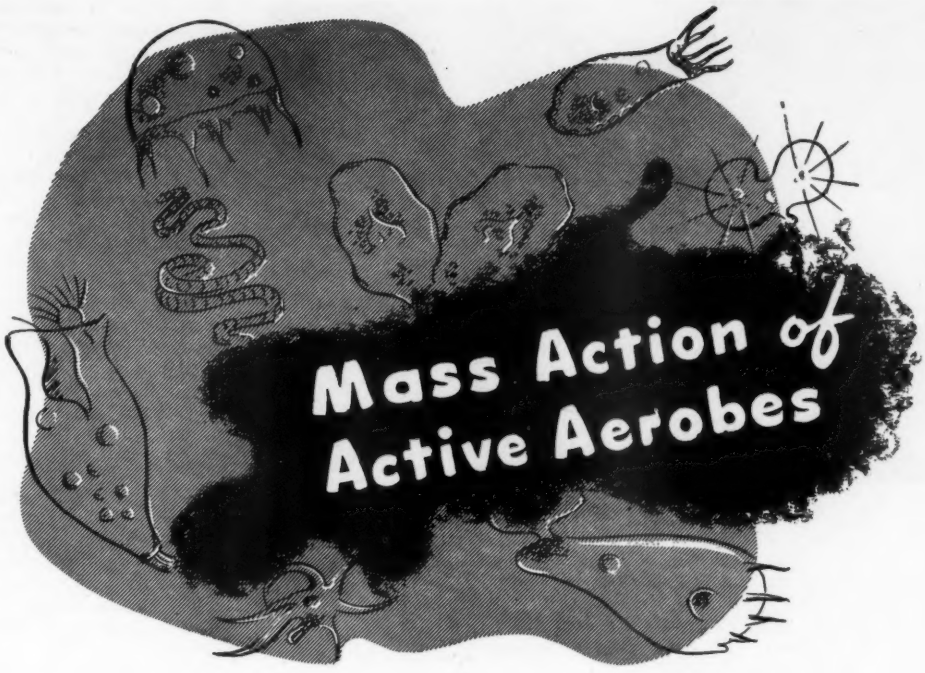
month of October. The average loading in this filter was 1.54 lbs. of BOD per cu. yd. of media, but varied from 0.91 to 2.12 lbs. Removal of BOD by the filter and final clarifier averaged 74.3%, with a minimum of 55.8% and a maximum of 80.9%. Overall removal averaged 83.8%, varying from 63.1% to 89.2%. Average BOD of the raw sewage was 278 ppm.

Detailed operating results are available for the first five months of 1945 for the single-stage plant at Rocky Mount, N. C. Average loading of the filters, for these 5 months, ranged from 0.17 to 0.27 lbs. of BOD per cu. yd. Raw sewage BOD ranged from 131 ppm to 233 ppm. Monthly average overall removals were: January, 90%; February, 88%; March, 89%; April 93.8%; May 93%. The average monthly BOD of the effluent varied between 14.3 ppm and 20.4 ppm.

Removal of BOD in the primary clarifier at Ft. Jackson averaged 29%; at Rocky Mount, this was not given; at the other plant primary BOD removal averaged 37%.

Media, Ventilation And Floor Slopes

In the interest of better filter ventilation, media 3" to 4" in size should be provided. Also Accelo "Hi-Cap" underdrains, (formerly known as Armcre Type AA underdrain blocks)



Provided by DIRECT RECIRCULATION *through* ACCELO* FILTER

Mass action of active aerobes gives better reduction of organic matter in sewage and improves the final effluent. It is provided by the ACCELO FILTER system, which returns directly to the filter large quantities of the unsettled trickling filter effluent teeming with active aerobic bacteria, thus increasing to myriads the number of active aerobes in the filter.

It is the UNSETTLED trickling filter effluent returned DIRECTLY to the filter that provides Mass Action of active aerobes. The aerobic bacteria in the unsettled effluent have been well supplied with oxygen and are in their most active state. Their span of life is from 3 to 5 minutes, and within that time they divide and multiply. To take advantage of this tremendous activity, the Accelo Filter system returns the unsettled effluent directly to the filter.

Write for authentic operation reports of Accelo Filter plants for proof of improved treatment results. INFILCO Inc., 325 West 25th Place, Chicago 16, Illinois.

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IF YOU WANT TO KNOW — ASK INFILCO

Fig. 6. Distributor with aero-spray nozzles.

which were developed for use with high-rate filters, should be provided. These underdrains with 53 square inches of duct area per linear foot of width, provide an increased area for flow of sewage and air, together with ample opportuntiy for lateral ventilation. Where the plant site topography permits, it is advisable to provide a filter floor slope of 0.5 to 1.0% although gradients as low as 0.3% have been used with satisfaction. Likewise the filter collection channel should have a slope sufficient to assure a cleansing velocity of about 2 ft. per second with ample area above the liquid level in the channel for air flow, with resulting improved ventilation. It will be noted that the increased floor and collection channel slope will make it possible for the filter to take care of greater than design capacities should unknown future demands require it.

Pumping Details

If available head at the plant site permits gravity flow through the entire plant, recirculation pumps controlled by an automatic float switch in a control well will serve to maintain a predetermined constant head on the distributor. The filter effluent well and pumps for this system are shown in Figure 4. Where pumping at the plant site is required the same pumps may be used for both functions of lift and recirculation, also as shown in Figure 4, where material to be directly recirculated flows over a weir from the filter effluent well into a wet well which receives settled sewage from the primary clarifier. The liquor surface elevation and consequently the head on the weir are more or less fixed by the effluent weir level of the final clarifier, consideration being given to clarifier feed pipe and other losses. Any well constructed open-impeller type centrifugal sewage pump or axial flow pump may be used for this service. The axial flow pump provides the most economical unit for the higher discharge rates.

Typical Plant Layout

A typical plant layout of a high-rate or high-capacity Accelo-Filter with lift and recirculation pumps is shown in Figure 5, which includes, grit remover, Griductor, Parshall flume flow meter, primary clarifier, primary clarifier wet well, control well, Accelo-Filter, filter effluent well, final clarifier, digester and sludge drying beds. Although the layout described above and shown in Figure 5 refers to a high-rate Accelo-Filter, the direct recirculation system may be advantageously used in the design of any biological filter at any desired filter dosage rate. The plant layout would be much the same as that shown except that the filter would be larger. The direct recirculation system is not limited to high rates of application. The data shown on the curves of Figures 2 and 3 may be used as a guide in the selection of the desired dosage rate for any particular project.

The pumps should be in duplicate so as to provide for standby service, and the entire plant, including the distributor, must be designed to handle maximum flow rates. Where there is gravity flow through the plant, and recirculation pumps only are to be provided, the plant and distributor should be designed with a maximum discharge capacity equal to the total capacity of all recirculation pumps plus the average flow rate. Where lift and recirculation pumps are used the entire plant and the distributor should be selected to discharge a maximum volume equal to the total discharge from all pumps. The discharge of any reaction driven rotary distributor is directly proportional to the square root of the head; therefore, if a distributor discharge range greater than about 2 to 1 is required a four-arm distributor is needed. This is arranged so that only two arms will discharge at low flow rates and all four arms at maximum flow rates. Usually a two-arm rotary distributor will be the most economical, provided the capacity range is suitable. For better aeration the use of aero-spray nozzles is recommended with the centerline of the distributor arms placed about 8" to 12" above the level of the filter media.

The Accelo-Filter system requires no greater operation knowledge or technique than is required for any conventional biological filter. The use of automatic float switches to operate the recirculation pump or the recirculation and lift pumps may eliminate manual attention to the only function not present in the conventional filter. Continuous application of sewage to the filter tends to eliminate difficulties with

(Continued on page 54)

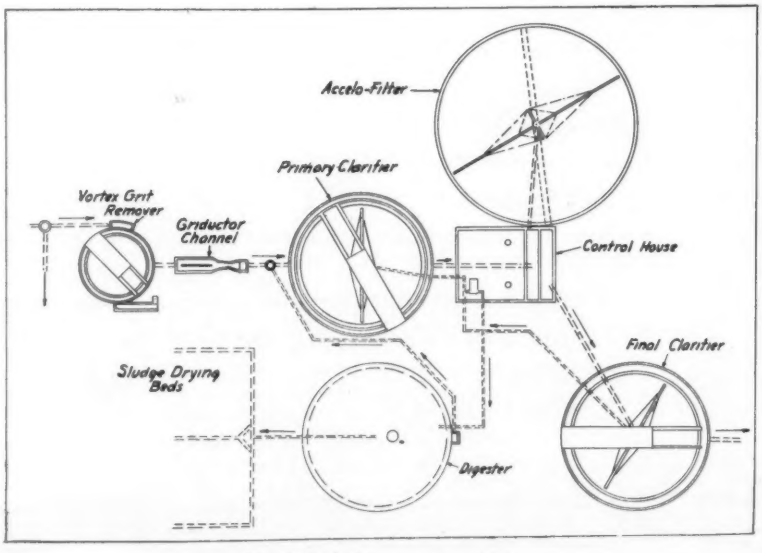
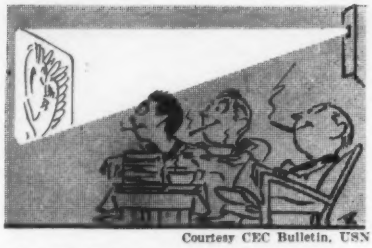


Fig. 5. Typical layout of a plant.



Courtesy CEC Bulletin, USN

To the instructor: Let them sit back in comfortable chairs.

An Outline for an Instruction Course for Water Department Personnel

Material on which to base instruction for water department personnel to insure better operation in more plants. Text references and instruction aids.

The Editors wish to thank the following for their helpful advice and suggestions: H. E. Moses, H. G. Baity, H. E. Babbitt, E. S. Hopkins, V. M. Ehlers, Rolf Eliasson, R. N. Clark, L. K. Clark and W. W. Towne.

THIS material is intended to provide summaries of outlines for the preparation of lessons or lectures for an instruction course for water department personnel. It can also be used as a planned guide for individual study, the text references cited after each heading providing the necessary information on where to find the material. These outlines are designed to broaden the base of usefulness of the various special articles that have been published in this magazine previously, such as *Operation of Water Treatment Plants, Water and Sewage Chemistry and Chemicals,* and *Hydraulics Simplified,* by preparing more waterworks men to utilize them better.

Excluding the section on *Public Relations,* there are eight principal divisions of this outline, five of which are published in this issue, leaving three to be published later. Under these eight groups, there are summaries of forty-three individual lectures. The nine principal divisions can be utilized, if time is restricted, as nine one- or two-hour lectures; or all of the outlines can be used to provide the full course of forty-three lectures. Generally some compromise will be desirable; not all of the subjects covered will apply to every community; and those that do not, can be omitted without loss of continuity. In all cases, since State Health Departments are vitally concerned with the production of pure water, they should be consulted regarding all details.

We believe that training of this type should be provided for its personnel by every one of the larger cities; and that State Boards of Health, in coordination with suitable Colleges and Universities, should furnish, or cooperate in furnishing, instructors to groups of personnel from smaller communities. There are thousands of alert and highly capable men employed in water departments, many of whom have not had formal engineering training. This magazine is convinced that everything possible should be done to equip these men to progress to higher levels of service, income and responsibility; in doing that better water works operation will be assured.

Texts and References

Specific references to appropriate texts are given under each lecture heading, but the number of references has been limited in order not to impose a financial burden on anyone, and where possible the texts listed are those that are most likely already to be available. Texts referred to are:

Standard Methods of Water and Sewage Analysis, current Edition.

Water Supply and Purification, by W. A. Hardenbergh, 2nd Edition.

Water Supply Engineering, by H. E. Babbitt, and J. J. Doland, 3rd Edition.

Manual for Water Works Operators, 2nd Edition, Texas Water Works Short School. (Order from State Dept. of Health, Austin, Texas.)

The Water Works Manual, 1947 Edition.

Water and Sewage Chemistry and Chemicals.

Operation of Water Treatment Plants.

Hydraulics Simplified.

(The last four are published by this magazine.)

All texts mentioned, except Standard Methods and the Texas Manual, will be furnished to students at a discount; write the Editor for information on discounts for single or quantity sales. Other helpful texts are listed at the end of this article.

Questions which may be used in connection with the lectures are listed at the ends of some of the chapters in the Texas Manual; and in Babbitt & Doland the questions are in an appendix.

Public Relations

It is recommended that the first lecture in any program be devoted in part to public relations, and that it be based on the excellent material on this subject that is currently being issued by the American Water Works Association. It is believed that, with the cooperation of that Association, it will

Courtesy Roberts Filter Mfg. Co.

Operating floor of a filtration plant.

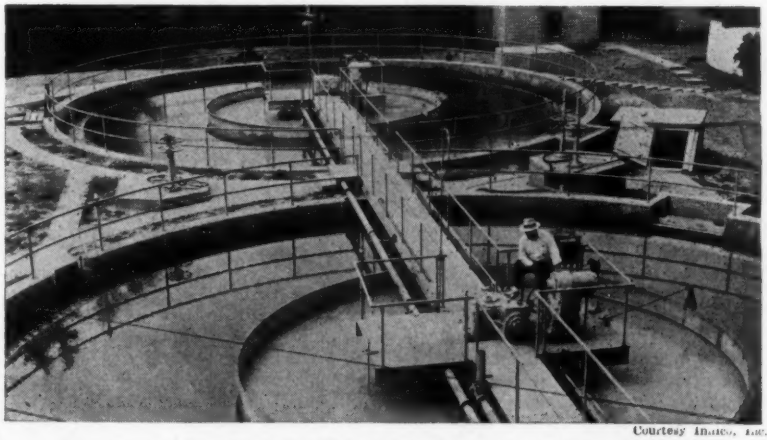
On-the-Job Training Program Department Personnel

be possible to obtain the services of a leading engineer or operator and to provide him with the material and the exhibits necessary to present the subject. This lecture should be a part of the program for the first meeting and should be coordinated with the participation of local municipal officials and State Department of Health and University representatives. If time permits, a film such as Clean Waters (G. E. Co.) may be shown.

I—Introductory and Orientation

The first four outline summaries cover introductory material and are intended to provide for the presentation, in the most effective way, of the succeeding material, and to broaden the student's viewpoint. If circumstances justify or require, these four can be combined into one.

1. *Value of a Water Supply.* — A water supply under pressure is an asset of great value to a community. Not only does it increase property values and reduce fire insurance rates, but it also reduces materially the amount of sickness in a community. It does this by eliminating the use of local wells and springs, many of which are constantly or frequently contaminated. It permits the installation of water-flush toilets, eliminating insanitary outdoor toilets. However, a piped water supply reaches practically every home and therefore it must be safe and free *all of the time* from bacteria causing disease. A contaminated well or spring affects only the relatively few people using it, but a contaminated public water supply may affect a large proportion of the population of a community. Principal diseases that are spread through water, in the United States, are diarrhea, dysentery, and typhoid and paratyphoid fevers, all of which are caused by bacteria that are found originally only in sewage and their presence therefore indicates sewage contamination. In addition, a supply of good water attracts industries and manufacturing plants, and thus contributes to the prosperity of a community.

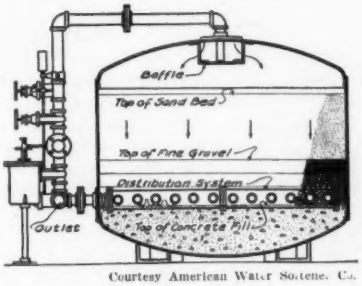


Courtesy Infilco, Inc.

A water softening installation of 6 mgd. capacity.

References.—Hardenbergh, pars. 1, 2, 270-276; Babbitt & Doland, Chap. XXI; Texas Manual, Chaps. I, III, and XIII; Operation of Water Treatment Plants.

Instruction Aids. — An engineer from the State Department of Health, a properly qualified consulting engineer, or a professor of sanitary engineering may be asked to give this lecture. Exhibits may include curves of disease incidence before and after safe water and instances of mass infections resulting from contaminated water, in both cases using examples from the locality or state where possible; slides of bacterial forms; and slides showing local bacterial counts over a period of time, with proper explanation of bacterial standards. Show film, Behind the Water Tap (Infilco, Inc.)



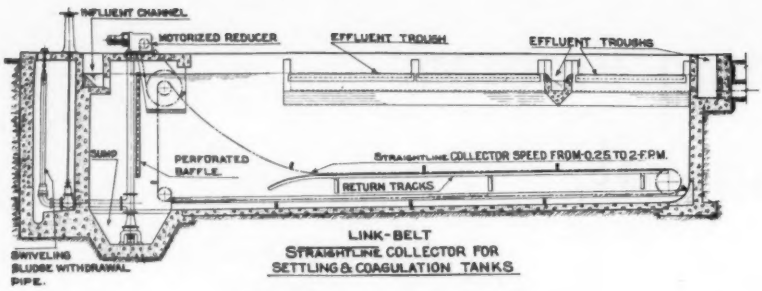
Courtesy American Water Softene. Co.

Section through a pressure filter.

2. *Functions of a Water Department.*—The first obligation of a water department and of its personnel is service to the community. Water department or water company employees of all grades, from the lowest to the highest, are public servants. As such, they are responsible for assuring the quality of the water distributed to the community. The water must be attractive in appearance, and free from objectionable taste, odor, hardness, corrosion or other undesirable factors that may influence people to use private wells, springs or other unsafe supplies. Water works personnel are also responsible to the municipality or the company for properly operating this business so that it will pay sufficient returns to cover interest on and amortization of the bonds; repairs, maintenance and operating costs; and extensions and improvements. They are responsible for public relations, that is, for the creation and maintenance of understanding and interest in the water works on the part of the citizens of the community.

The municipality or the water works management also have responsibilities to those working in the water department, including: Security, or the assurance that the employee will be retained by the department as long as he does his work properly; retirement provisions; safety, or the adoption and enforcement of safe working practices and methods; and the provision of training facilities, with opportunity for advancement, so that the capable employee can become more valuable and will be granted more responsibility, with a chance to increase his income.

Reference.—Texas Manual, Chapter XIX and Appendix A.



Section through a settling tank.

Instruction Aids.—A chart of the water department organization, showing the various divisions, bureaus or sections; AWWA literature and material on public relations; map showing areas served by the water department and also those areas not served but which may or should be served; hydrant location map to show fire protection.

3. *Sources of Water Supply.*—Rainfall is the source of all water supply, whether taken from surface sources, as streams or lakes, or from underground sources, such as wells or springs. Rainfall measurements are made primarily by the U. S. Weather Bureau, but many departments maintain gauging stations. In most areas, the years of lowest rainfall will show 60% to 65% of the average over a long period, and the years of highest rainfall about 150% to 170% of the average. These cycles of rainfall are generally irregular and unpredictable. Monthly variations are important and, in estimating the amount of surface water available from a stream, the months and years of lowest rainfall are important and should govern design. Stream flow records are more valuable than rainfall in estimating the amount of water that may be obtained from a given watershed, but there is a reasonable relation between the two. Rainfall-runoff formulas may give fairly reliable results but a capable hydrologist should interpret the results. When estimating the amount of water available from a lake or reservoir, evaporation must be considered as this may exceed the amount of rainfall on the water surface. Deep ground waters, which are normally used by municipalities, are more nearly independent of local rainfall because the sources from which they draw water may extend over hundreds of miles distant. Ground waters are normally clear, with a low bacterial content (except in some limestone areas), but may contain undesirable dissolved minerals and gases, as calcium, sodium, iron, magnesium, manganese, and carbon dioxide.

References. — Hardenbergh, pars. 34-87. Texas Manual, Chaps. II and IV. Babbitt & Doland, Chap. IV.

Instruction Aids.—Charts showing a long time rainfall record and a monthly record for a year; compare this with the monthly consumption data. If the local supply is from surface waters, show map of the watershed; and local rainfall data; and if from wells, typical underground water strata and if possible, a local well log. Show how rainfall is measured. Estimate trend of future local water use.

4. *Amount of Water Used.* — The amount of water used by a community is the total of that used for domestic consumption, that lost by leakage and waste, the amount used for public purposes, and the industrial and business consumption. This averages about 100 gallons per person per day, but may be more or less in any community. Use of water during the maximum month may be 125% of the average month; the maximum day's use may be 170% of the daily average; and the hourly maximum may be 250% of the average; variations in large cities are often less than in small ones. Leakage and waste may amount to 15 to 40 gals. per person per day; public use is almost insignificant, the use for street and sewer flushing and fire protection usually not exceeding an average of 3 to 5 gals. per cap. per day. Industrial and business requirements, including air conditioning, depend almost wholly on local conditions. Each community should study carefully its water needs and usage, including daily and hourly demands so that the capacity of the reservoirs, distribution system and other facilities will be ample. The cost of producing the water should also be known, including the amount required for interest on the original cost, amortization, maintenance and operation and treatment.

References. — Hardenbergh, pars. 16-33. Texas Manual, part of Chap. XV. Babbitt & Doland, Chap. V. Water Works Manual.

Instruction Aids.—Charts of maximum and average daily consumption for several years past with probable leakage, waste and unaccounted for water shown in red. Charts of cost of operation, including all items; and of income.

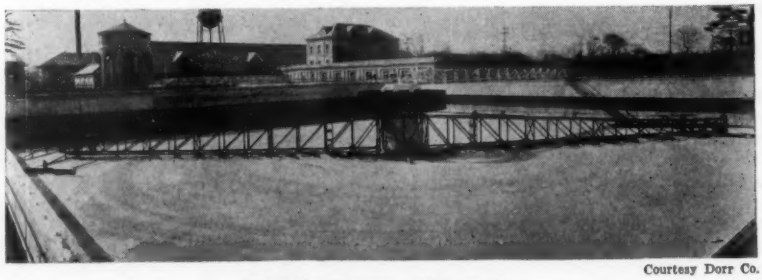
II—Treatment of Water

The following nine digests of outlines consider the various methods of water treatment. Usually all of these will not apply to any one community. It is suggested that the major part of the time available be spent in discussing the methods of treatment used or applicable locally, always including chlorination; and that the remaining subjects be combined in one lecture or lesson.

5. *Need for Treatment.*—Water in its natural state may contain impurities which make treatment necessary. These impurities range in character from those that affect health to those that are merely annoying or displeasing. *Bacteria* of certain types may cause disease; other micro-organisms may impart color, taste or odor; *suspended materials* may cause turbidity or muddiness; *minerals and dissolved gases* may cause hardness, make the water corrosive, form deposits on pipe interiors, or impart other undesirable characteristics. The principal purpose of water purification is to destroy or eliminate the impurities that may cause disease; the secondary purpose is to remove or neutralize dissolved gases, minerals, turbidity, color, taste, odor, hardness, corrosiveness and other impurities that may be objectionable to householders, or may make the water unfit for use by industries. Treatment is accomplished by storage, screening, sedimentation, coagulation, filtration, chlorination, aeration and the use of chemicals.

References. — Hardenbergh, pars. 274-280 and 282-285. Texas Manual, Appendix B. Babbitt & Doland, Chap. XXII.

Instruction Aids.—Demonstrate color, turbidity, taste and odor, hardness, corrosiveness and other impurities, as



Courtesy Dorr Co.

A 200-ft. diameter settling tank.

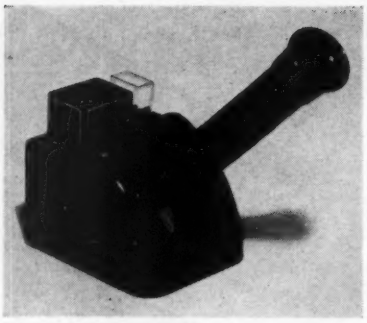
practicable. Show map of surface water supply with possible sources of contamination, as houses, barns, factories, milk plants, etc., spotted on it. Show film, Health in the Cycle of Water, (Cast Iron Pipe Research Ass'n.)

6. *Examination of Water.*—Examinations of water may be classified as physical, chemical, bacteriological, microscopic and mineral. These tests are made to determine the characteristics of the water so as to plan necessary treatment procedures; to measure the effectiveness of treatment; and to provide a basis for estimating the cost of treatment. *Physical* examinations are made to determine temperature, taste and odor, turbidity and color. *Chemical* examinations are made to determine hardness, pH, alkalinity, acidity, chlorides, residual chlorine, iron, manganese, nitrogen and other characteristics. *Bacterial* examinations are made to determine the presence of bacteria, and their numbers, types and origins. Bacteria are very small, those commonly found in water being 1 to 4 microns in length (a micron is 1/25,000 inch); they are classified according to shape, as round or spherical (cocci); rod-shaped (bacilli); and spiral (spirilla). *Microscopical* examinations are made to identify algae, fungi, rotifera and other very small organisms, and sometimes bottom sediments. *Mineral* analyses are made primarily for industrial purposes.

References. — Hardenbergh, pars. 346-352; Texas Manual, Chaps. I, X, and XI. Babbitt & Doland, Chap. XXIII.

Instruction Aids.—Demonstrate some or all of the common physical and chemical tests; illustrate a few bacterial forms and demonstrate some of the methods of isolating them; demonstrate use of microscope for examining water. Explain purpose and scope of sanitary survey.

7. *Chemistry and Chemicals.*—Alkalinity and acidity, which are important in water works, are measured in two ways, the intensity by the pH scale and the quantity in parts per million by reaction with an acid or alkali. Chemicals unite in certain definite proportions, as 98 parts of sulphuric acid and 56 parts of lime to form 136 parts of calcium sulphate and 18 parts of water. Every chemical is designated by a letter or combination of letters which shows its composition, as N for nitrogen, Na for sodium, Cl for chlorine, O for oxygen, H for hydrogen, CaO for lime, etc. In order to measure the reactions of chemicals, and determine the amounts present standard solutions are necessary. These contain a specific known amount of the chemical substance in a definite volume of solution. Since the metric system is especially convenient for use in the laboratory, the water works man should be familiar with it, though it is not necessary for him to know the ounce or pound equivalent of, for instance, a milligram, gram or liter. The



The Wallace & Tiernan orthotolidine-arsenite tester for determining free chlorine residuals.

basic chemical knowledge needed in the water works field can be obtained by anyone with a reasonable amount of study, which should be supplemented by laboratory work under guidance in the water plant or by short courses at a college or university, as are provided by most State Sanitary Engineering Divisions one or more times a year.

References. — Hardenbergh, pars. 305-331. Standard Methods. Texas Manual, Appendix E. Babbitt & Doland, Chap. XXIII Water and Sewage Chemistry and Chemicals.

Instruction Aids.—Explain metric system briefly; show pH indicator and explain its use; also equipment for determination of alkalinity and acidity; and laboratory apparatus for a few simple determinations.

8. *Sedimentation.* — This type of treatment may be employed with or without coagulation. The former is used where suspended material is coarse enough to settle; when it is necessary to remove natural material that is too fine to settle, a coagulant is added, normally aluminum sulphate or ferric sulphate or other iron salts. These are added by chemical feed machines in amounts based on laboratory tests or experience. The average dosage of coagulant is around 1 grain per gallon or 142 pounds per million gallons, but this may vary considerably with the turbidity and the character of the water. The coagulating chemical must be mixed vigorously with the water; this is accomplished either by mechanical mixing apparatus, such as revolving paddles or rotating blades, or by passing the water rapidly over and under, or around, a series of baffles. The chemical reacts with the alkalinity in the water, as calcium bicarbonate, or with added alkalinity, as lime, to form a floc which attracts and enmeshes the small particles in the water and settles rapidly to the bottom. The reaction, when using aluminum sulphate is:

$$\underset{\text{Aluminum Sulphate}}{Al_2(SO_4)_3} + \underset{\text{Calcium Bicarbonate}}{3Ca(HCO_3)_2} = \underset{\text{Calcium Sulphate}}{3CaSO_4} + \underset{\text{Aluminum Hydroxide}}{2Al(OH)_3} + \underset{\text{Carbon Dioxide}}{6CO_2}$$

The detention period in the mixing chamber is usually 20 to 45 minutes and the velocity of the water ½ to 1½ ft. per second. After mixing, the floc is settled in sedimentation tanks, having a retention period of about 4 hours. Sedimentation is practically always followed by filtration.

References. — Hardenbergh, pars. 359-400. Texas Manual, Chap. VIII. Babbitt & Doland, Chaps. XXIV and XXV. Operation of Water Treatment Plants. The Water Works Manual (for equipment).

Instruction Aids. — Demonstrate settling with and without a coagulant; show how to perform the jar test to determine the required chemical dosages; demonstrate the necessity for good mixing in order to obtain a good floc.

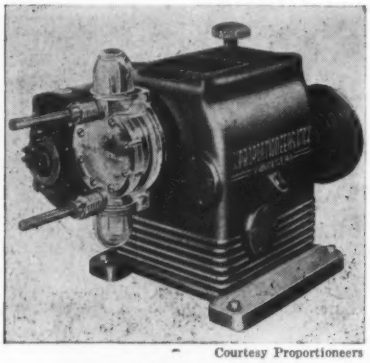
9. *Filtration.*—The rapid sand filter is almost universally used in municipal water treatment. This consists of a filter bottom of strainers, perforated pipe or other device of a similar nature, on top of which are placed several layers of gravel, coarse on the bottom and fine at the top, having a total depth of about 18 ins.; and on top of the gravel, about 24 to 30 ins. of sand or finely crushed anthracite. In some cases, porous plates replace the filter bottom and the gravel. The coagulated and settled water is applied to the top of the sand bed and allowed to filter through it at a controlled rate of about 2 gals. per minute per square foot of filter surface. The filter is normally enclosed in a concrete tank, and is equipped with valves and controls to maintain a proper rate of flow through the filter. Owing to the relatively high rate of filtration, the sand clogs with suspended matter, including small floc particles which are not entirely removed by settling. Normal operation may result in clogging in 45 to 70 or more hours; the filter is then washed by stopping the inflow of water and forcing clean filtered water upward through the strainers, the gravel and the sand. Agitators and mechanical devices may be used to aid in washing, which requires only a few minutes. A properly operated filter removes practically all of the impurities, including bacteria from the water.

References. — Hardenbergh, pars. 401-434. Texas Manual, Chap. VIII. Operation of Water Treatment Plants. The Water Works Manual (for equipment) Babbitt & Doland, Chap. XXVI.

Instruction Aids. — Show by diagrams or slides the construction of a filter and explain the mechanism of filtration; filter previously coagulated and settled water through a small sand filter or, if necessary, through a paper filter.

10. *Chlorination.*—Water that has been treated by coagulation, settling and filtration should be clear and should contain few bacteria. In order to destroy the remaining bacteria, if there are any, the water should be chlorinated. This procedure provides a

factor of safety against plant breakdowns or lapses in the treatment process; also, through the persistence of an adequate chlorine residual, the safe quality of the water is maintained after it has entered the distribution system and until it reaches the consumer. If only a small amount of chlorine is added to the water, the residual may not persist, or it may be combined with organic matter or with ammonia to form chloramine, which is a slow-acting disinfectant. If enough chlorine is added to destroy the organic matter and the nitrogen compounds in the water, a free chlorine residual will result which will be more effective in bacterial destruction. Orthotolidine and



Courtesy Proportioneers

A solution feeder.

other tests are used to determine the amount and kind of chlorine present. Chlorine is usually applied by a chlorine gas feeder in the case of large installations, or a solution feeder and hypochlorite solution at small plants.

References. — Hardenbergh, pars. 435-459. Texas Manual, Chap. XII; Babbitt & Doland, 602-610. The Operation of Water Treatment Plants. The Water Works Manual (for equipment).

Instruction Aids. — Demonstrate a chlorinator, a hypochlorinator, the use of hypochlorites, and the various residual tests for chloramines and for free chlorine residuals. Demonstrate safety measures.

11. *Taste and Odor Control*—Tastes and odors in water supplies are usually caused by plant growths of the algae type, although industrial wastes, especially those containing phenols and the discharges from synthetic rubber plants, canneries and dairies, and some of the dissolved minerals may cause tastes. There are many varieties of algae, some of which are especially prone to cause tastes and odors. These should be collected and identified. Other possible sources of trouble should be investigated. Copper sulphate may be used to destroy algae or prevent their growth. The amount required depends on the type of algae; therefore early collection and identification are important. Chlorination, sufficient to produce a free residual is often helpful in preventing the development of taste and odor causing organisms. Activated carbon is effective in removing or reducing the intensity of tastes and odors; generally it should be applied just before coagulation, but in some areas, it is more effective if applied just before filtration. The average dosage is about 2 ppm, but local conditions may require less or sometimes much more. There are many grades and varieties of carbon and if one is not effective, another may be. Preventive measures are especially important, such as keeping algae concentrations below the taste level, keeping the reservoirs and units of the treatment plant clean, and eliminating or properly treating industrial wastes. Ammonia when used with chlorine may prevent the formation of chloro-phenolic tastes and odors. Ozone may be helpful in taste and odor control.

References. — Hardenbergh, pars. 490-508. Texas Manual, Chap. XIII. Babbitt & Doland, 620, 627. Operation of Water Treatment Plants. The Water Works Manual (for equipment and materials).

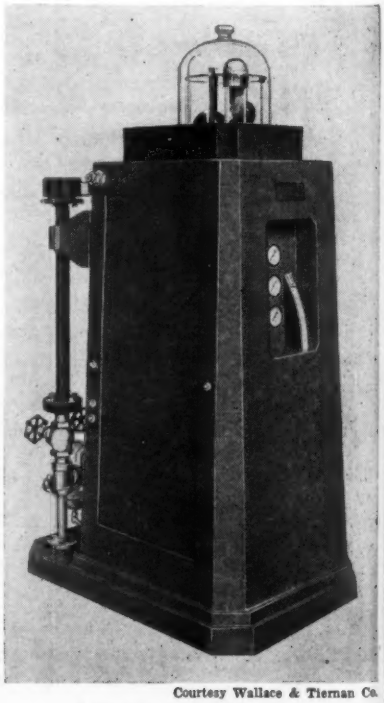
Instruction Aids.—Show slides or pictures of algae and identify common organisms. Demonstrate collection and examination methods. Demontsrate taste and odor tests.

12. *Softening.*—Hardness of water is due principally to calcium and magnesium compounds, either bicarbonates (sometimes called temporary hardness but properly called carbonate hardness), or sulphates, chlorides and nitrates (sometimes called permanent hardness but properly termed non-carbonate hardness). The principal disadvantages of hard water, aside from the increase in soap consumption, the formation of scale in boilers and heaters, the effect on piping and the reduction in life of textiles, is the unsuitability of hard water for laundry and many other industrial uses. One method of removing hardness is by the addition of lime, or of lime and soda ash, followed by settling and filtration, and sometimes by recarbonation to prevent any excessive deposit of calcium carbonate in the distribution system. About 10.75 lbs. of lime are needed per million gallons of water for each part per million of free or half-bound carbon dioxide for the removal of carbonate hardness; about 9.25 lbs. of soda ash are required per million gallons of water for each part per million of non-carbonate hardness it is desired to remove; and about 4.6 lbs. of carbon dioxide per million gallons of water for each part per million of calcium carbonate to prevent deposition. Zeolites, which are also used to soften water, are sodium aluminum silicates with the ability to remove calcium and magnesium from the water while giving up sodium. When the zeolite sodium content is exhausted and the zeolite will no longer soften water, it is recharged or regenerated with a salt solution. The choice between these two methods depends on local conditions. Zeolites are usually placed in small pressure tanks.

References. — Hardenbergh, par. 460-474. Texas Manual, Chap. XIV. Babbitt & Doland, Chap. XXVII. The Water Works Manual (for equipment.) Operation of Water Treatment Plants.

Instruction Aids. — Perform soap test. Show pipe samples with deposits and heater tubes with scale, illustrating the effect of mineral-bearing waters.

13. *Corrosion.*—Some waters attack iron or steel pipes, that is, they are corrosive. The degree of corrosion depends primarily on two factors—the relationships of the pH and alkalinity, and of the free carbon dioxide and alkalinity. By modifying these relationships, it is possible to prevent serious corrosion in the pipes of a water system. There are also available certain chemicals, as the metaphosphates, which minimize or prevent corrosion, and the silicates, which form a protective coating on the interior of the pipes. Aeration will reduce the carbon dioxide content of a water to about 3 ppm. but it may increase the dissolved oxygen content and therefore increases the tendency to corrosiveness. Carbon dioxide can be removed by adding lime, soda ash or caustic soda, or by passing the water through beds of crushed limestone; all of these also increase the alkalinity. For instance, 1 grain per gallon of lime (95% pure), or 142 lbs. per million gallons, will remove 9.65 ppm. of carbon dioxide and will, at the same time, increase the alkalinity of the water. Similarly the pH value of the water can be raised by the addition of other alkalies, as sodium carbonate, which also increase the alkalinity. In general, corrosion is prevented by maintaining such a relation-



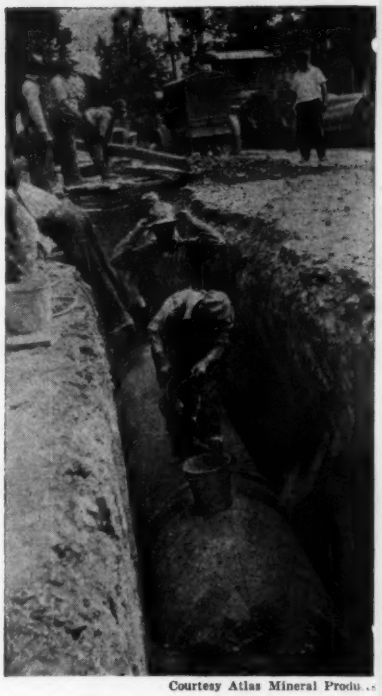
Courtesy Wallace & Tiernan Co.

A large capacity chlorinator.

ship between pH and alkalinity that a relatively thin calcium carbonate coating is deposited on the pipe interiors, or by using chemicals to prevent corrosion or provide a resistant lining on the interior of the pipe.

References. — Hardenbergh, par. 482-489. Texas Manual, Chap. XVII. Babbitt & Doland, 332-342, 631-635. The Water Works Manual.

Instruction Aids.—Demonstrate tests for pH and alkalinity, and the marble test; demonstrate effect on characteristics of the water of the addition of lime and soda ash. Show samples of corroded pipes.



Courtesy Atlas Mineral Produ...

Pouring a joint for a water main.

III—Safeguarding Water Quality

14. *Reservoirs.*—It is important to prevent dangerous contamination of the raw water, certainly in such amounts as might tax treatment facilities, or of such quality as would cause tastes and odors, or interfere with the treatment process. Sources of raw water contamination may include inhabitants on the water shed; highways or railroads crossing the drainage areas; hunters, campers, picnickers, fishermen or bathers; industrial plants; and farm animal yards, barns, etc. Surveys should be made, in addition to bacteriological tests, to determine the sources and extent of contamination. Protection may be passive—promulgation of rules, warning signs and fences; or active—patrolling. In any case, where a situation arises, whether it be an industry or a farm, an acceptable solution must be available. Aid may be obtained from the health department. Distributing reservoirs need more protection than watersheds or raw water reservoirs as the water in them is usually consumed without further treatment; a chlorine residual in them may be desirable. Fencing of a reservoir is often desirable — a low tight fence to keep out small animals, salamanders, etc.; and a higher fence to prevent trespassing; or the two may be combined. Some reservoirs are covered, not only to prevent contamination, but to eliminate algae growth in them. Maintenance of an adequate chlorine residual is important and is facilitated by covers.

References. — Hardenbergh, par. 102 and 106-117. Texas Manual, Chap. III. Babbitt & Doland, 200-205, 474-476.

Instruction Aids. — Show map of local or other typical watershed with all sources of potential pollution spotted on it. Discuss the best method of correcting each of these. Show location map of distributing reservoirs.

15. *Cross Connections and Backsiphonage.*—A cross-connection is a physical connection to another water supply, unapproved, or of inferior quality; to a plumbing fixture; or to anything else whereby contaminated or polluted water can enter or be drawn into the distribution system. Common examples may include: A private well or other source of fire or industrial water supply which is connected to the piping of the public supply; the connection for providing make-up water for a swimming pool; the overflow connection between an air conditioning unit and a sewer; and connections between the water system and lines or pumps handling sewage or process water. In addition there is the possibility of backsiphonage, which may occur with improperly designed plumbing fixtures resulting in the contents of toilet bowls, bath tubs and other fixtures being drawn into the water system if a negative pressure exists in the water pipes. To prevent this, faucets and other inlets to bath tubs and lavatories must terminate above the maximum water level possible in the fixture; and toilet and urinal bowls must be equipped with proper vacuum breakers. To prevent danger from cross-connections, these must be located and eliminated.

References. — Hardenbergh, par. 273, 276 and 435. Texas Manual, Chap. XIX and appendix B. Babbitt & Doland, 451.

Instruction Aids.—Show by actual models or examples, or by diagrams, the common types of cross-connections and hazardous plumbing fixtures. Discuss state or local laws or ordinances and explain their provisions.

16. *Other Sources of Contamination.*—Among other methods by which the water in the mains may be contaminated are: Workman cutting into or repairing broken or leaking pipes; even if contamination does not result directly from such work, the disturbances created by draining the pipe preparatory to repair, the concentration of flow through other pipes, and re-establishment of flow in the repaired section may cause high bacterial counts. Newly laid pipe must be disinfected before use, as it is especially prone to contain contamination due both to handling and storage before laying, and to certain of the joint materials, especially jute, which may continue to increase bacterial counts for a considerable time. Negative pressures in pipe lines are always dangerous because they tend to draw other liquids in the pipes; therefore, the distribution system should be well-constructed and amply large to carry all needed flows. Sewer and water lines should not be placed within 6 ft. vertically or 10 ft. horizintally of each other, unless both are exceptionally well constructed of the best materials. In general, contamination can be prevented by good materials, good construction and the maintenance of a clearly perceptible chlorine residual.

References. — Hardenbergh, par. 176-192. Texas Manual, Chap. XV. Operation of Water Treatment Plants. Babbitt & Doland, 97, 429.

Instruction Aids. — Demonstrate method of sterilizing newly laid pipes. Show methods of cleaning water pipes before they are laid and of plugging ends when work ceases at night.

IV—Pipe Line Materials

17. *General.*—Pipes for water works systems, whether used for supply lines, mains, laterals or house services, should be durable, so that it will not be necessary to replace them except after very long service, and so that leaks will not develop. They should be of such design as to facilitate the construction of joints which will remain permanently tight; the pipe material should not impart any taste or odor to the water; and the interior of the pipe should be smooth to facilitate the flow of water, since a smooth pipe may carry as much as 10% or 20% more than a rough one. The kinds of pipe in use in water works distribution systems include cast iron, transite, steel and concrete; and for house service pipes, generally copper, brass, steel and wrought iron.

18. *Cast Iron Pipe.*—There are several varieties of cast iron pipe, the standard bell-and-spigot being most

When you need special information—consult the classified **READERS' SERVICE DEPT.**, *pages 93-97*

commonly used. Cast iron pipe is made in sizes up to about 36 ins. in diameter; and normally in 12-ft. and 16-ft. lengths, though longer pipe may be supplied, and Universal pipe is made in 6-ft. lengths. Cast iron pipe is made in four weights and thicknesses, for heads from 100 ft. up. The bell-and-spigot pipe is joined by using oakum and molten lead or other suitable joint material; Universal pipe has a mechanical joint held together by bolts. Flexible joints are available for special problems, as stream crossings. Specials, including curves, tees, sleeves and reducers, are available for connections. Cast iron pipe is dipped in a bituminous coating material to minimize corrosion and tuberculation, which in some areas are serious problems. Also, cast iron pipe is sometimes lined with a thin layer of cement, which is placed by centrifugal action.

References. — Hardenbergh, par. 131-144. Texas Manual, Chap. XV. The Water Works Manual. Babbitt & Doland, 314-330.

Instruction Aids.—Films are available from the Cast Iron Pipe Research Association; also literature and technical data and booklets from the same source.

19. *Cement-Asbestos Pipe.*—Transite pipe is a mixture of asbestos fiber and portland cement. It is made as a plain end pipe in 13-ft. lengths. Jointing is by means of mechanical joints, usually the Simplex, though other joints, as the Dresser, may be used. Transite pipe is furnished in four classes for pressures from 100-ft. head up, and sizes up to 24-inch. Cast iron specials are usually used for making connections. Transite pipe is resistant to corrosion, tuberculation and electrolysis, has a smooth interior, with consequent good hydraulic properties, and is light in weight.

Courtesy Johns-Manville Corp.

A line of pipe laid on a curve.

References. — Hardenbergh, par. 159. Texas Manual, Chap. XV. The Water Works Manual. Babbitt & Doland, 329.

Instruction Aids. — The Johns-Manville Co. has a film showing the manufacture and methods of laying and jointing transite pipe.

20. *Steel Pipe.* — The principal use of steel pipe is for supply lines, as it is not well adapted to the taps and small connections necessary in a distribution system. It is therefore used mainly in the larger sizes — 30-inch and larger—and is furnished in rather long sections to simplify jointing, which may be by welding or with Dresser joints. Steel pipe is usually designed for a specific job, having a known pressure. The necessary thickness can be computed from the formula: thickness = psi X pipe diameter ÷ 2 X safe stress in steel X efficiency of joints. For 300 lbs. pressure and a 30-inch pipe, thickness would be (using 16,000 lbs. safe stress and 70% joint efficiency) about 0.35", or 3/8 in. Cast iron specials are used for most connections. To prevent corrosion of the steel, pipe is coated inside and out with a bituminous compound or enamel or is covered with concrete. Stresses due to deep backfill should be computed carefully, and air relief valves are necessary at intervals to relieve suction and prevent collapse in case of a break with consequent rapid emptying of the line.

Courtesy Lock Joint Co.

Concrete pressure pipe.

References. — Hardenbergh, par. 145-150; Texas Manual, Chap. XV. Water Works Manual (for materials). Babbitt & Doland, 322, 374.

Instruction Aids. — Literature from manufacturers. Show Dresser joints, and diagrams of riveted joints; show welded joints. Also show how air relief valves work.

21. *Concrete Pipe.*—Concrete pipes used in water works include the Lock-Joint and Preload. As with steel, this pipe is used mainly in supply lines in sizes 24-inch to 30-inch or larger. It, also, is specially designed for the conditions of each job, and may be constructed locally. Cast iron specials are used. Concrete pipe is unaffected by corrosion or tuberculation and has good hydraulic properties.

References. — Hardenbergh, par. 155-158. Texas Manual, Chap. XV. Water Works Manual (for materials). Babbitt & Doland, 327, 376.

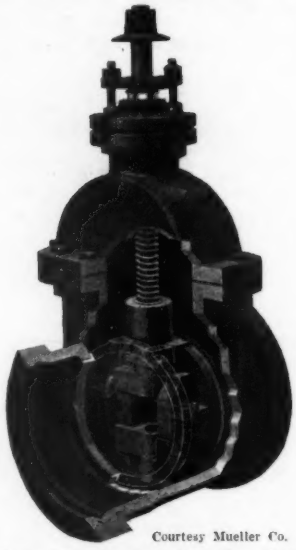
Instruction Aids. — Literature from the manufacturer. Section through pipe, showing joints and reinforcing.

22. *Service Pipes.*—The pipes connecting the street mains with the house plumbing are normally small, ¾-inch to 1½ ins., and consequently are rather susceptible to stoppage. Therefore, materials resistant to corrosion, as wrought iron, copper or brass are preferable. Connections are made by drilling a hole in the street main and screwing a valve, called a cock, into the main; then a lead connection, called a gooseneck, is fastened to the cock and to the service pipe. Since the connection must usually be made with the water main under pressure, a special tapping machine must be used. The size of service pipe required depends on the water demand, which in turn depends largely on the number of bathroom fixtures (in residential buildings).

References. — Hardenbergh, 160-161. Texas Manual, Chap. XV. Public Works, April, 1947 (for pipe sizes required). Babbitt & Doland, 330-332, 439, 440.

Instruction Aids.—Demonstrate and explain tapping. Show how to compute pipe sizes for some typical buildings using the methods and charts in Public Works for April, 1947, or similar data.

23. *Valves, Hydrants and Meters.*—Gate valves are placed on all mains and submains at intervals of 500 to 800 ft., and generally on both sides of pipe line intersections so that the effect of breaks will be minimized and repairs



Courtesy Mueller Co.

Phantom view of a gate valve showing mechanism of the gate assembly.

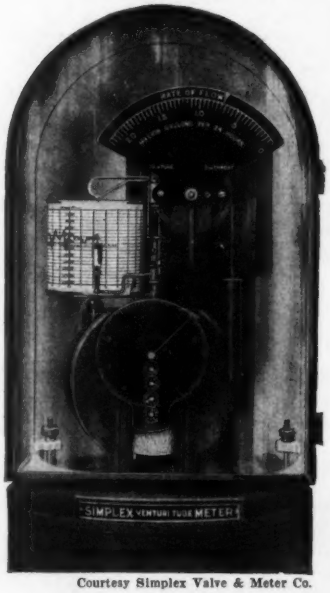
can be made without interrupting service in more than a small part of the distribution system. Hydrants permit the water supply to be used for extinguishing fires, and therefore should be so placed as to provide ample water for all expected emergencies, generally so that at least two lines of hose can reach any building; the National Board of Fire Underwriters recommend hydrant spacings of 200 to 300 ft. in well built-up areas. Meters are of two general types — those used on mains and those placed on house services. Venturi type meters are usually placed on mains, but propeller type meters may be used where the velocity is moderately uniform and sufficient to operate them. Service water meters are usually of the disk type, though other types are used. Each community should provide adequate inspection and testing for valves, hydrants and meters to insure their proper operation.

References. — Hardenbergh, par. 162-175. Texas Manual, Chap. XV. Water Works Manual (for equipment). Babbitt & Doland, 343-362.

Instruction Aids. — Show sectional views of valves, hydrants and meters. Show how the Venturi meter operates and explain the use of pitot tubes. Show proper placement of hydrants, and the placement and location of valves, including methods of setting and recording their location. This lecture, as regards service meters, may be tied in with a meter maintenance school.

V—Hydraulics

24. *Units of Measurements.*—The foot, the gallon, the pound and the cubic foot are generally used units of measurement in the United States, Canada and England, but the gallon in Canada equals about 1.2 U.S. gallons. In those countries employing the metric system, the meter (39.37 ins. or 3.28 ft.), the kilogram (1000 grams or 2.20 lbs.), the liter (1.06 qts.), and the cubic meter (or stere, which equals 1000 liters or 264.15 gals.) are used. In water supply, time-volume units are also necessary to designate the amount of water required per minute, hour, day, or year, such as gallons per minute (gpm), gallons per day (gpd), millions of gallons per day (mgd), cubic feet per second (cfs = 7.48 gals. per second). Also storage capacity may be measured in gallons or in acre-feet; an acre-foot is an area of one acre (43,560 sq. ft.) one foot deep, or 43,560 cu. ft., or 325,829 gals. The inch is used in the U.S. to designate pipe sizes, as 1″, 6″ or 30″; in countries using the metric system, pipe sizes are stated in millimeters or centimeters (mm. or cm.); a 200 mm. or 20 cm. pipe is



Courtesy Simplex Valve & Meter Co.

Venturi Tube Meter.

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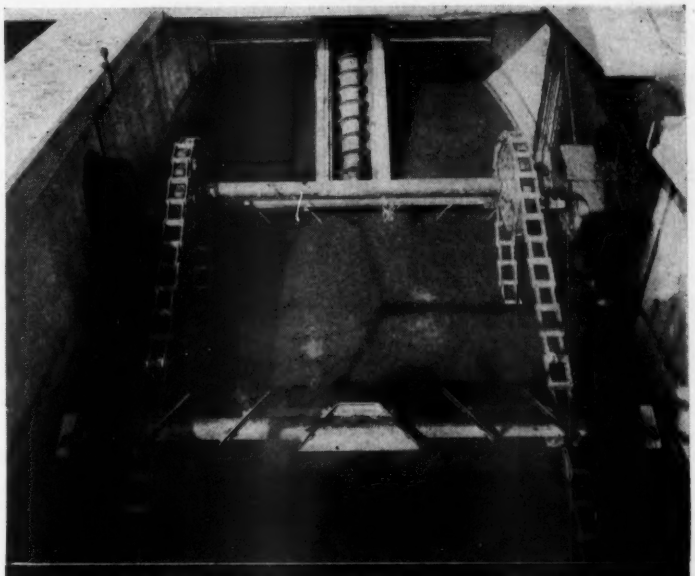

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In addition to grit handling and washing equipment, Link-Belt Company manufactures a complete line of equipment for water, sewage and industrial waste treatment such as Straightline and Circuline sludge collectors, screens, mixers, scum breakers, aerators, dryers, power transmitting, elevating and conveying machinery. Send for catalogs.

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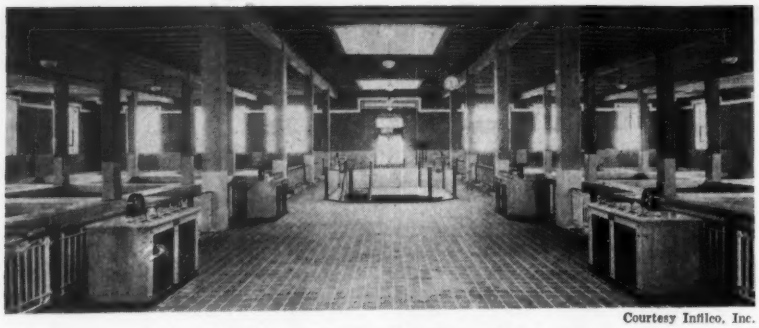

Courtesy Infilco, Inc.

Operating floor of the filtration plant at Tulsa, Okla.

about 7.87" in diameter; threads are also different. In Europe, American pipe required adjusters to be of use in repairing damaged water works.

References.—Hydraulics Simplified.

25. *Heads and Pressures.* — The pressure of water against the bottom and sides of a tank or the walls of a pipe is a factor of the weight of the water, which is 62.4 lbs. per cubic ft., or 8.3 lbs. per gal., and the resulting pressure is 0.43 lb. per sq. in. for each foot of elevation of the water column. The pressure per sq. in. or sq. ft. is the same for any area or volume of water, large or small, and depends wholly on the depth or head. The pressure of the air (the atmospheric pressure) at sea level is 14.7 lbs./sq. in. (less at higher elevations) and this pressure determines the depth from which a pump can lift water by suction. At sea level this is 14.7 ÷ 0.43 or 33.9 ft., theoretically, but due to friction, probable small air leaks and other losses is actually about 26 or 28 ft. At 2000 ft. above sea level, the possible lift is about 2 ft. less. A mercury column may be used to measure the air pressure, and each inch of mercury equals about 13½ ins. of water. *Static head* is the difference in elevation between the free water levels at the two ends of the pipe. *Effective head* is the static head less friction and other losses. *Velocity head* is that part of the head required to produce the velocity of flow that exists in the pipe and is found by the formula $vh = V^2 \div 2g$, or $V^2 \div 64.4$. The effective head at any point less the velocity head is the *pressure head*. The *hydraulic gradient* is the line joining the elevations to which the water in a pipe line would rise while water is flowing through the pipe.

References. — Hardenbergh, par. 219. Hydraulics Simplified. Babbitt & Doland, Chap. III.

Instruction Aids. — Show pressure with gauge. Use barometer to indicate air pressure. Demontrate action of a siphon.

26. *Flow of Water in Pipes.*—The amount of water that will flow through a pipe depends upon many things including: (1) The size of the pipe, since the larger the cross-sectional area, the more water it will carry; (2) the length of the pipe, for the longer it is, the greater the friction; (3) the head of water on the pipe, for this contributes to the velocity in the pipe; (4) the condition of the pipe interior, for a smooth pipe will carry more water than a rough one, and an old pipe is likely to become rougher and is generally not capable of carrying as much water as a new pipe; and (5) the number of valves, tees, ells and other fittings, all of which contribute more resistance to the flow of water than does straight pipe. Naturally it is difficult to make proper allowances for all these factors, but several reliable formulas have been developed on the basis of observation, experience and study. The formula most generally used is the one proposed by Hazen & Williams, in which an allowance is made for the roughness of the pipe interior by using a factor C, which may vary from 90 for cast iron pipe 25 or 30 years old to 140 for best, new straight cast iron pipe. The pipe size influences the friction, even though the velocity is the same, the friction loss being less in the larger pipe because the proportion of water in contact with the pipe walls is less; but pressure does not affect friction, unless the greater pressure results in greater velocity. The friction due to valves, tees and other fittings is provided for by considering them as added lengths of pipe. For instance, an 8-in. standard elbow has the same friction as 21 ft. of straight pipe.

References.—Hydraulics Simplified. Hardenbergh, par. 219-224. Texas Manual, Chap. VI. Babbitt & Doland, 48-58.

Instruction Aids.—Show how each of the various factors affect flow and how each is provided for in standard formulas. Illustrate common specials and show relative friction equivalent. Demonstrate some of the mathematics of hydraulics.

27. *Tables and Charts.*—All of the formulas for flow of water in pipes are complicated and for general use it is better to employ nomographic charts or tables. These are published in most standard texts on water works, and they cover practically all sizes of pipe, pressures, velocities and friction losses. The nomographic charts cannot be read precisely in most cases, but they are amply accurate. For instance, a supply line is designed for conditions assumed to exist a number of years in the future, and the condition of the pipe interior at that time cannot be foretold. Also, computations of the flow in long pipe lines may be 5% to 10% in error, under the best of conditions; and actual flows over weirs, even when all conditions are carefully controlled, may be 5% at variance with computed results. Finally, pipe is made in certain standard sizes. If computations should show the need for a 9-in. pipe, a 10-inch, which is the next largest standard size, would have to be used. However, the fact that such approximations are necessary does not diminish in any way the necessity for careful and accurate preliminary investigations, the collection of ample reliable data, and precision in mathematical calculations.

References.—Hydraulics Simplified. Hardenbergh, par. 207-236 and Fig. 78. Texas Manual, Chap. VI. Babbitt & Doland, 57.

Instruction Aids.—Show charts or slides of a good nomograph and explain its use. Show tables of flow and explain use.

28. *Measuring Flows.*—Devices for measuring flows include meters, pitot tubes, orifices and weirs. Meters are of three principal types—disk, current and Venturi. Disk meters are limited to relatively small pipes; and current meters, which consist of a wheel with curved blades which is inserted in the pipe, are accurate only when velocities in the pipe are uniformly above about 2 ft./sec. Venturi meters are suitable for pipes larger than 4" or 6"; they utilize the principle that when the velocity of the water is increased, the pressure is decreased. Orifices can be used in either of two ways: At the end of a pipe section or inserted in the line, as in a joint; a pressure gauge is placed about one pipe diameter back from the orifice and the flow computed by a simple formula. Flow can also be measured by timing the discharge into a tank of known capacity; or by computing the flow through an orifice in the side of a tank; and also, though only approximately, by the discharge from a hydrant equipped with a pressure gauge. Flow over a weir provides one of the most accurate methods of measuring discharge.

References.—Hydraulics Simplified. Hardenbergh, par. 168-170 and 218-225-236. Texas Manual, Chap. VI. Babbitt & Doland, 32-39.

Instruction Aids. — Show by diagram, slide or model, each of these methods of measuring flow and explain the principles of operation of each.

The final installment of this article, covering Pipe Line Construction, Maintenance, and Pumps, will appear in the September issue.

Modern Sewage Treatment Plants

require equipment that has proved itself efficient and is backed by individual responsibility for design, engineering, fabrication and initial operation.

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TRICKLING FILTERS

(Continued from page 36)

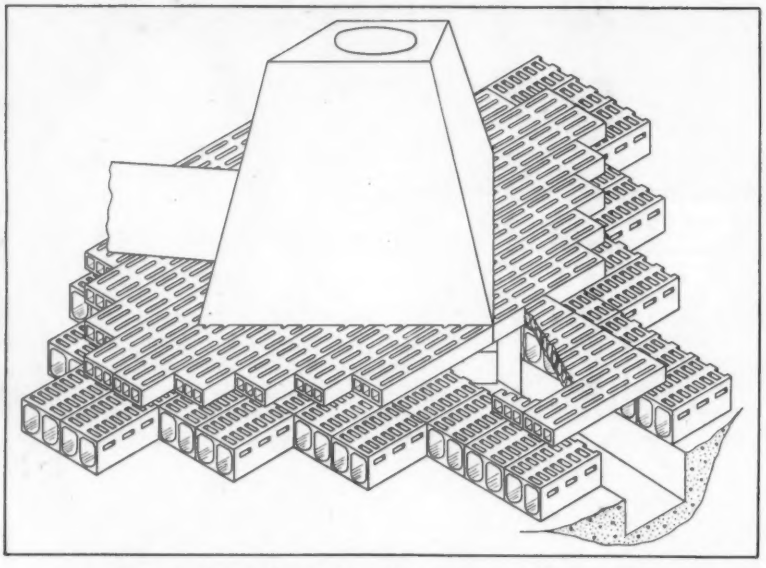

Fig. 7. Simple method of laying underdrains around distributor pier.

odors and psychodae flies. Inoculation of sewage, as it is applied to the filter, with fresh, well aerated filter effluent in addition to repeated passages of the sewage through the filter produces increased reduction in organic content of the sewage undergoing treatment.

The usual procedure in the treatment of normal domestic sewage is to recirculate 100 to 200% of the average sewage flow rate. For the treatment of high strength organic waste, a much higher rate of recirculation may be necessary to produce the desired results and several stages of treatment may be needed.

The first plant scale Accelo-Filter went into operation in the late fall of 1940. Since that time there have been more than 25 such plants installed with an equal number in various stages of design or construction at present.

Calculating the Capacity of a Traffic Lane

Simplified methods of calculating traffic capacity are presented in an article by W. Jacobson, in *Engineering*. Average values of 1 sec. for reaction time and 6 yd. for vehicle length are assumed and braking distance is taken to be directly proportional to speed. Equations are also derived to illustrate the effect of crossings and the need for sufficient space for vehicles waiting at crossings. Graphs prepared from the above formulae indicate that the capacity of a lane increases rapidly up to a speed of about 15 m.p.h. but from 15 m.p.h. to 50 m.p.h. no great increase is apparent. Crossings and consequent stoppages considerably reduce the speeds at which maximum traffic capacity is obtained. (Note:—A communication by A. J. H. Clayton, published in *Engineering*, 1946, 162 [4221], 544, points out that the braking distance is usually assumed to be proportional to the square of the speed. Vehicle spacing has also been found to depend on the square of the speed and traffic capacity thus passes through a maximum at a critical speed and declines at higher speeds. The formula for the effect of crossings only applies where they are so close as to warrant control by linked signals.)—*Road Abstracts.*

Garbage Disposal in San Francisco

San Francisco's garbage weighs about 700 pounds per cubic yard, with 23% combustibles, 27% non-combustibles, and 50% moisture. Average monthly collections aggregate 18,300 tons, and the collection organization operates on a 310-day year. Disposal has been by sanitary fill for a number of years, and the cost, according to the records of the company having this contract, averaged 95.4 cents a ton, varying from $1.025 per ton in 1936 to $0.885 in 1945. During this time, the depth of garbage placed under a 2-ft. cover of earth has increased from 2.58 ft. to 6.17 ft., based on an assumed weight of compacted garbage of 1400 lbs. per cu. yd.

Test pits dug early in 1946 in a portion of the sanitary fill which had been in place since 1934, were sunk to a depth of 9 ft. Material contained in the garbage layers showed very little evidence of decomposition, with specimens of fruits and vegetables appearing practically as fresh as the day they were buried. Carrots, corn, lemon and grapefruit peel retained their original colors; tin cans were bright and showed no evidence of rust. Freshly uncovered garbage yielded a strong decomposing odor. Temperatures near the bottom of the pits were higher than at or near the surface, the difference varying from 2 to 10 degrees.

Extracts From Comments on the Training Article in This Issue

"I have read with the greatest interest the material you sent. . . . Used . . . by competent people who may carry on the training of water department personnel, I believe this summary will serve an exceedingly useful purpose." *H. G. Baity,* Professor of Sanitary Engineering, University of North Carolina.

"Generally speaking, I think this summary is very good. Obviously there are many important considerations omitted, especially re health hazards, but it ought to be a helpful guide in conducting on-the-job training programs. Those in charge must use their good judgment in presenting the material and in organizing the classes." *L. K. Clark,* Project Manager, Sanitation Research Project, Joint Committee on Railroad Sanitation, Association of American Railroads.

"I believe that anyone interested in the operation of water works, who would have an opportunity to pursue this course, would receive a valuable education on both the principles of water works operation as well as many of the details of specific items. It seems to me that this project will meet a need in the water works field for the training of the men who actually operate the system." *H. E. Moses,* Chief Engineer, Pennsylvania Department of Health.

"The outline is certain to be most helpful to anyone interested in giving information on the subject of water works and will help me as a foundation for some of my lectures." *H. E. Babbitt,* Professor of Sanitary Engineering, University of Illinois.

". . . the material you have submitted should be extremely useful to water departments and various organizations concerned with the training of water works operators." *V. M. Ehlers,* Chief Engineer, Texas Department of Health.

". . . you have done an excellent job in working this material up, and it is a matter that will receive favorable reaction from the water works industry, particularly the employees who are looking forward to jobs as operators or better." *R. N. Clark,* Chief Public Health Engineer, Tennessee Valley Authority.

Public Works Engineering Methods and Data

Highway Maintenance Needs and Costs

Essential abstracts from a report by a Committee of the Highway Research Board, National Research Council.

Road maintenance costs on state highway systems in 1941 totalled more than 203 million dollars; and for all roads, maintenance costs in that year were estimated at 659 million dollars. These figures, and the data herewith, are from the progress report of the Committee on Highway Maintenance Costs of the Highway Research Board, J. S. Bright, chairman. In an effort to determine the dollar needs for maintenance in the post-war period, the committee has investigated many of the items entering into these costs.

Labor in 1941 ranged from 20 cents to 70 cents an hour and averaged 46 cents. In 1945, wages varied from 35 to 92 cents an hour and averaged 65 cents. The average wage of operators of light equipment, in 1941, was 57 cents an hour and in 1945 79 cents. The average pay of maintenance patrolmen, in the same period, rose from 59 cents to 87 cents an hour. On the basis of these classifications, composite labor costs rose 42% in the 1941-45 period.

Material costs, on the basis of composite costs of a number of maintenance materials, rose 30% in the four years, 1941 to 1945. *Equipment rental* rose only 29%, in the four years, and the rate of increase used was based on the composite rise in the cost of new equipment, since depreciation rate methods did not appear to give a true picture of the increase in costs, supplies and labor rates. *Overhead* costs, including engineering, administration, transportation, rent, supplies, etc., rose 27% above the 1941 level.

Composite maintenance costs are based on 45% of the expenditures going to labor, 21% to material costs, 25% to equipment and 9% to overhead. On these bases, the total composite cost of maintenance operations in 1945 was 35% above the 1941 level.

Deferred maintenance is of two types, that which causes no lasting detriment to the highway, as mowing, and painting traffic lines; and that which does cause detriment and must still be performed, such as drainage, seal coats and bridge painting. Based on man-months of labor employed, it is estimated that there is a deficit in maintenance work of about 22% which must be made up. In addition, states need some 47 million dollars worth of new equipment, including: 9801 trucks; 446 shovels, cranes and draglines; 132 bituminous distributors; 506 compressors; 1488 motor graders; 376 loaders; 974 power mowers; 321 heavy rollers; and 540 snow plows. (These figures do not include county and city needs, which are believed to be much greater—Ed).

1945 maintenance costs appear to be high, as indicated by the following examples: For patching concrete pavement with concrete, three states reported average costs of $6.92 per sq. yd.; the average cost of a light bituminous treatment, as reported by five states, was 10 cents a sq. yd.; the average cost of two light 75-pound mixed-in-place treatments was 21 cents a sq. yd.; the average cost of four heavy 200-pound surface courses was 76 cents a sq. yd.

Cost reducing methods appear to be under process of development. One state has used a joint and crack-filling machine, which reduced costs from $15.90 per mile to $8.64. Another state reduced the cost of pe-

Proper handling of bituminous materials is essential in maintenance.

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riodic ditch cleaning from $100 per mile to $48.96 by substituting a mechanical loader for hand loading. Another state reported ditch cleaning was reduced approximately 50% from $107 per mile by use of a mechanical loader.

Breakpoint Chlorination at Iron Mountain, Mich.

By J. F. RUBBO
Supt. of Filtration

The water supply for Iron Mountain, Mich., is derived from Lake Antoine and from local mines which supplement the yield of the lake. The lake water has a turbidity produced mainly by microscopic organisms, which not only shorten filter runs but also produce tastes and odors. Treatment of the lake water has consisted of alum coagulation and filtration, with carbon for taste and odor control, and chlorine for disinfection. All chemicals were added to the suction side of the raw water pump. Results of this treatment were good, but a public bathing beach on Lake Antoine, which has as many as 7,000 patrons in a single day, caused some concern and indicated the desirability of a more effective treatment.

Laboratory tests, supplemented by two plant scale runs of one week each, indicated that the lake water responded satisfactorily to breakpoint chlorination, and this method was therefore adopted. The average chlorine dosage is 3.7 ppm, varying from 2.1 to 7.4 ppm. The point of control is the water on top of the filters, where a free chlorine residual of 0.5 to 0.7 is normally maintained, though at times the residual is as high as 2.0 ppm. The water leaving the plant usually carries a free chlorine residual of 0.4 to 0.5 ppm.

A few days after this treatment was started, complaints were received about a "muddy" taste. Investigations showed a highly colored and turbid water in the mains, with an organic slime growth. This was cleared by a thorough flushing program which, in our opinion, is essential whenever breakpoint treatment is initiated. Corroded water meters, also coated with organic matter, contributed to taste and odor. As these difficulties were overcome by flushing mains and cleaning meters and other appurtenances, complaints ceased. Results from the use of breakpoint chlorination have been highly satisfactory and have solved many of our problems.

Construction Trends and Activity

Contracts awarded, according to the Federal Works Agency, during the first quarter of 1947, show a considerable increase over the corresponding period of 1946, as follows: Highways, 161 million dollars for 1947, as compared to 113 million for 1946; sewerage, 27 million dollars as compared to 16 million dollars in 1946; water supply systems, 32 million dollars, as compared to 31 million. The total contracts for state and local public works for the first quarter of 1947 total 348 million as compared to 220 million during the same period of 1946.

Estimated new construction through 1947 is 12,250 million dollars, including 1,250 millions for state, county and municipal highways and streets; 175 million for sewerage; and 150 million for water works. The total of 325 million for sewerage and water works compares with 194 million in 1946 and 192 million in 1940.

Trailer Eliminates Re-handling of Incinerator Ashes

By L. T. BRUHNKE

To eliminate re-handling of the garbage incinerator ashes, Wauwatosa is now using a four-wheel dump trailer instead of dumping on the ground and later loading into a truck with a mechanical loader. It was sometimes difficult to spare an equipment operator to run the loader at the time when the ash crew wanted to move the ashes, and due to the building layout, a conveyor would have been too expensive. As two trailers were available, R. G. Everist, supervisor of mechanical equipment, suggested their use to Mayor William B. Knuese and City Engineer Henry B. Wildschut.

While a ramp could have been built, a pit eliminated the uphill push of the wheelbarrow. Ed Baumann, foreman of the street department, remembered some old building foundations which provided three walls for the pit, and these will be concreted later.

An easy way of handling incinerator ash.

The pit eliminates both unsightliness and a fire hazard. In the past, paper blowing about has caught fire when contacting hot ashes and at one time started a small shed fire. Paper cannot be blown into the dump body as easily and if it does, the chances of fire are greatly reduced.

Soil Cement for Highway and Irrigation Ditches

During the 1946 construction season the Alabama State Highway Department placed under contract more than 18,000 sq.yd. of soil-cement highway ditch and soil erosion control structures. This work was done in seven counties of the state. The structures varied from 3 to 12 ft. in width, depending on intended water-carrying capacities.

State highway specifications for this work require that the soil for soil-cement ditches shall be secured along the roadway ditches or from satisfactory nearby local deposits. Mixtures of 1 part portland cement and 8 parts by volume of loose, moist local sandy or sandy-gravel soil with sufficient water for workability have given satisfactory results when tamped into place and finished with a hand float.

During the initial hydration period of the cement a 1-in. layer of moist earth, cotton mats or paper blankets are specified for the retention of moisture and the prevention of surface marring in the completed soil-cement structure.

The U. S. Bureau of Reclamation recently constructed a 500-ft. irrigation ditch with a 4-ft. bottom and 1½:1 side slopes of 3- to 4-in. thickness, using plastic soil-cement, in the East Mesa-Imperial Irrigation District of California.

The plastic soil-cement mixture consisted of the existing blowsand soil known as Superstition Sand, approximately one sack of cement to 5 cu.-ft. of sand and sufficient water to produce a mortar consistency approaching that of a plastering mortar.

Materials were mixed in a small concrete mixer and placed while in a plastic condition on the ditch slopes and bottom. The surface was troweled to a smooth finish.

The Bureau also constructed plastic soil-cement head gates and turnout structures. A 1:4 mixture was used on the vertical structures and placed in forms while sloping walls were troweled into place.

There appears to be very little shrinkage on both the ditch and structures, and fine cracks appear at relatively long intervals.

Sewage Flow and Treatment Data, Richmond-Sunset Plant

The average daily sewage flow at the Richmond-Sunset sewage treatment plant, San Francisco, during the fiscal year ending 1946, was 10.3 mgd, an increase of 6% over the preceding year. Average dry weather flow was 9.6 mgd., and average wet weather flow 10.7 mgd. Total quantities of solids removed per million gallons were: 1.28 cu. ft. of screenings; 7.5 cu. ft. of grit; and 0.95 ton of dry sewage solids.

The sedimentation tanks received raw sewage having a weighted average suspended solids content of 240 ppm., and a BOD content of 230 ppm. The overall removal of suspended solids was 70%, and of BOD 44%. The effluent was chlorinated to maintain an average residual of 0.5 ppm. after a contact of 5 minutes; this required 80 to 100 pounds of chlorine per mg.

The digester has but 0.8 cu. ft. per capita capacity, but the average volatile content of the sludge was reduced to 67%, a reduction of about 61% of the volatile matter originally present in the raw sludge. Bottom sludge is pumped over the top of the scum layer in order to soften and seed the scum layer; this appeared to help in promoting digestion in this layer. Gas production averaged 0.8 cu. ft. per person per day. Sludge is elutriated, with a reduction of 80% in the alkalinity of the digested sludge, and then filtered. The average amount of ferric chloride was reduced to 4.37% of the dry solids. Deposits of iron oxide and scale on the filter screen were removed, when cloths were replaced, by rotating the drum for about 8 hours in a 20% hydrochloric acid solution inhibited with aniline oil.

Control of Midge Flies by Nature

The *Chironomid Natan*, commonly called the midge fly, which is quite prevalent around the basins of water treatment plants, finds an excellent environment for spawning in and around the final sedimentation basins at New York's Tallman Island sewage treatment plant. Here they are kept under control by leaving spider webs undisturbed. Numerous fat spiders spin large webs to trap the midges, and thus prevent them from becoming a nuisance.

Will It Pay to Install Machinery of Higher Efficiency?

By W. F. Schaphorst, M.E.

Do you operate an engine? Pump? Compressor? Fan? Or anything of the sort? Do you know what its efficiency is? Is it an old machine? Can you buy one that is more efficient? If so, at what cost? And how much can you get for the present machine?

Those are questions that you can probably ask yourself to good advantage, and if you can work out the answer you may find it well worth your while to buy new or better equipment.

Take pumps, for example. The average annual cost of power for operating the average pump is greater than the first cost of that average pump. Is that true in your instance? Or, how about the engine, compressor, or other machine? We are merely using "pump" here as a typical example.

So, assuming that yours is a pump, let us say that its efficiency is 60 per cent, which is not at all unusual, and you find that you can buy a pump having an efficiency of 70 per cent. There are pumps having higher efficiencies, to be sure, but just as an example let us use 70 per cent. Now, assuming that these two pumps are driven by motors of the same efficiency at the load required, and that the output of the pumps in theoretical horse power is 52 h.p., then you will find that the present pump requires a motor which is 10 h.p. greater in size than would be the motor required to drive a pump of 70 per cent efficiency.

To work this out, divide 42 h.p. by 0.60 and you get 70 h.p. as the present horse power required. Then divide 42 h.p. by 0.70 and you get 60 h.p. required by the more efficient pump, which amounts to a saving of 10 horsepower because 70 — 60 = 10.

Now let us say that the pump operates 24 hours per day and that your power costs one cent per horsepower-hour. If the pump operates continuously, 365 days per year, the power saving by installing the more efficient pump will amount to $876 per year. This is the way it is worked out: 10 x 24 x 365 x $.01 = $876.

Maybe your pump or other machine doesn't run continuously. If it operates only one-half of the time, the saving will amount to one-half of $876, or $438 per year. Or, if the pump operates only one-quarter of the time, the saving will be $219 per year. A saving even of $219 per year may make it worth while to install a new pump because you will find that $219 is equal to the interest on $3650 at the rate of 6% per year.

Efficiency can therefore be very important in many instances, as above. It is a good plan to delve into these matters every once in a while to determine whether or not you can make valuable savings by discarding inefficient machinery and installing in its place something that is more efficient. It is hoped that the above will prove helpful to many readers in showing definitely how to go at it when making comparative computations involving efficiencies.

Cost of Operating a Municipal Asphalt Plant

The municipal asphalt plant operated by the Department of Public Works of the City and County of San Francisco during the 12 months from July, 1945, to the end of June, 1946, produced 27,906 tons of asphaltic mix pavement surfacing at a total cost of $86,402 or $3.10 per ton.

The Effect of Sieve Loading on the Results of Sieve Analysis of Natural Sands

Experiments have been carried out at the Road Research Laboratory, Harmondsworth, England, to ascertain the effects of a number of factors on the results of sieve analysis of natural sands. The factors studied included the size of the sample, particle size distribution in the sample, and the duration of sieving. Microscopic examination showed that the particle shape was similar in all the materials tested regardless of size. The work showed that overloading of the sieves leads to inaccurate results and that reduction of sample size is a more effective remedy for overloading than sieving for a longer period. Values are given for the maximum desirable loading for a number of sieves, and recommendations are made for the adoption of a standard weight of sample for sieve analysis of natural sands. The most recent British Standard method for Sieve Analysis is based on this work.—*Road Abstracts.*

California Highway Radio Communications System

The State Highway Division of California is one of the few operating a radio communications system. There are, at present, 75 fixed and mobile stations throughout the state, and immediate expansion of the system is planned. The radio system is used principally for emergencies arising during the winter program of snow removal, snow plows being equipped with two-way radio enabling them to maintain constant contact with headquarters. Two-way radio has also been installed in the cars of state maintenance superintendents and foremen. It has been found that this is most advantageous in meeting emergencies arising from storms, slides or accidents requiring immediate attention.

Heating Sludge With Steam at San Diego

Steam was used for heating sludge at the San Diego, Calif., plant during 1945-46. Live steam was injected, under a pressure of 3 to 4 pounds per square inch, into the sludge before discharge into the digesters. The sludge is pumped into a constant-level box in which are placed four 4-inch perforated steam pipes. From this box, the sludge flows over a weir and by gravity into the digesters.

Landslide Correction by Subdrainage

During the fall of 1945, the Bureau of Engineering of San Francisco, installed a subdrainage system in a minor slide area on the upper side of O'Shaughnessy Boulevard. This slide had caused frequent upheaval of the roadway subgrade during wet winters with consequent hazards to traffic. The drainage system consisted of a main line of 8″ perforated vitrified clay pipe laid through the boulevard and extending upward along the contact plane under the slide and approximately along its principal axis, together with two laterals branching off on this southerly side. The pipe with a continuous cover of gravel was laid through short tunnels between shafts about 4′ x 6′ in section. which were excavated at intervals of 10 to 15 feet. The shafts were back-filled with gravel up to within five feet of the ground surface.

The main line of pipe, including the crossing of the boulevard was 300 feet long. The upper portion of the main line and the upper and lower laterals, which were 40 feet and 100 feet in length respectively, were in private property, by virtue of a special right of way agreement with the owner. The depth of the drain at the boulevard is 18 feet and at one point in the slope a maximum depth of 25 feet was reached. Three manholes were installed to permit access for future maintenance work.

Demand for Sewage Sludge in Florida

There is a great demand for dried digested sludge for fertilizer in Florida—more than can be met. One broker of fertilizer materials sold, between April and October, 1946, forty-five carloads obtained from Alabama and Ohio plants, and the 1947 demand is greater than can be supplied. The sludge is well suited as a conditioner of Florida's sandy soils.

Breakpoint Chlorination Experiences

(Continued from page 28)

ished water, usually 2 ppm. or under. In the past it had required, on several occasions, overfeeding of alum beyond amounts sufficient to form a good floc in order to get the desired color reduction. This resulted in unsettled floc reaching the filters and over-loading them. This caused shorter runs, and higher rates and longer periods of wash. The excess alum also reduced the pH, requiring post-treatment with lime for corrosion control and the post-lime in turn added soap hardness. The bleaching or decoloring effect of high pre-chlorine doses enabled us to cut the amount of alum to about ⅔ that previously used for raw water of the same color. Lime treatment was then shut down as the smaller amount of alum did not materially lower the pH. Filter runs were longer and operating troubles generally disappeared, showing how essential pre-treatment is for proper plant operation.

To illustrate the results of the decolorizing properties of break-point on our two types of raw supplies, the following typical examples are given: On the river emergency supply we have fed from 5 to 6 ppm. of chlorine at the suction of the pump and checked color reduction on the discharge side, 2300′ away. Raw river water had a color of 35 ppm. while the color of the treated water was 9 ppm. Later another laboratory test was conducted on a river sample, treated with from 5 to 6 ppm. of chlorine. Color, to begin with, was 38 ppm. Immediately after adding chlorine, we checked and it was down to 18 ppm.; at the end of 4 hrs., it was down to 5 ppm.; free chlorine was 2.0 ppm. at the end of the test. On our regular impounding reservoir supplies the maximum reduction appears to be 70 to 75% on raw water, with a color of 25 to 30 ppm., leaving a final color of about 8 ppm. During the winter months, when coagulation is difficult because of cold water, the filters will handle low turbidities, from 10 ppm. down. Without alum, and with prechlorination at 4 to 5 ppm., a raw water with a color of 23 ppm., becomes a filtered water having 2 ppm. of color. In the past, coagulation during the winter months was for the sole purpose of getting color down; now chlorination does a better job without alum at much less cost, and the finished water has a "sparkling" look.

Bacterial improvement since the beginning of "Break-Point" is rather difficult to compare due to extremely low plate counts on the raw. In addition to the better appearance, we no longer have an increased

soap hardness, which was sometimes as much as 17 ppm. greater in the delivered than in the raw. The delivered water is satisfactory to all concerned, especially the general public.

Chlorine Demands in the System

The chlorine demand through the plant at present (early 1947), with prechlorination at 2.60 ppm. and post-chlorination at 0.72 ppm. is: 0.9 ppm. through the mixing basin, baffle chamber and settling basins, over approximately 4 hrs., 0.15 ppm. through the filters, (filters having approximately 550 hrs. of run at time of test), 1.43 ppm. through the open filtered water basins, requiring another 30 to 36 hrs. Demand in the distribution system varies depending on the concentration of chlorine. For instance, water leaving our open filtered water basins, with a free residual up to 1.2 ppm will give residuals in the system varying from 1.15 ppm. about 1½ miles from the plant, to 0.35 ppm. on dead-ends approximately 3½ miles from the plant. In the business section, approximately 2½ miles from plant the residuals will average 0.85 ppm. All of these are "free residual chlorine." On the other hand water leaving these same open filtered water basins with a free residual of 0.25 to 0.35 ppm. will give residuals at the above mentioned locations of 0.2 ppm., 0.08 ppm. and 0.12 ppm. Therefore, demand in the system as well as through the plant appears to depend on the amount of residual available to begin with. Demand through open filtered water basins varies considerably depending on weather conditions. There is always a loss during the daylight hours, particularly if the day is clear and bright. During the night the residual again increases. There isn't much that can be done to control this variation with open basins. We have checked residuals in these open basins at the surface and at a depth of about 8'. From these tests it would appear that the surface or top water is dechlorinated only slightly.

In connection with these same open filtered water basins, break-point eliminated a former necessity of treating with copper sulphate to control algae during the summer months. Cosmarium, the chief offender, formerly, floated to the surface in large patches of greenish yellow scum. During the past two summers we haven't used a pound of copper sulphate in these basins and there hasn't been a sign of development of any variety of algae. Growths and slime formation on the filter walls have been definitely retarded. Ordinary pre-treatment, in the past, did not furnish chlorine in sufficient quantity to control such slime and growths on the filter walls.

Changing Over to Ton Containers

With the increased consumption of chlorine it became apparent that we should change over from 150# cylinders to ton containers. This change resulted in a substantial saving in cost of chlorine. The total cost of the change over, doing all the construction work ourselves, was just under $350. This included a new 2-ton chain-falls, "I" beams, and other materials and equipment.

Tanks exposed to the weather, out by the settling basins, were subject to extreme pressure variations which caused liquefaction in both machines and feed line. Installation of a pressure reducing valve eliminated these difficulties. We have been down to 20° below zero and the lowest pressure registered on the machine gauges has been 8#, which was sufficient to operate without trouble.

It is difficult to show, by comparison of past and present costs, all of the savings due to the use of break-point treatment, as other changes were made at about the same time. There is no question of the very marked chemical treatment cost savings, resulting from the elimination of alum during the winter months and carbon and ammonia the year around, plus a reduction in the lime needed for pH control. The absence of mud-balls in our filters may be attributed to better coagulation, the Anthrafilt filters and the extremely efficient action of the Palmer agitators. Certainly, the unusually long filter runs, (as high as 1000 hrs., and frequently 500 to 700 hrs.) and the satisfactory results without coagulant during the winter months, must be credited largely to break-point treatment.

Copper Sulphate Is Still Needed

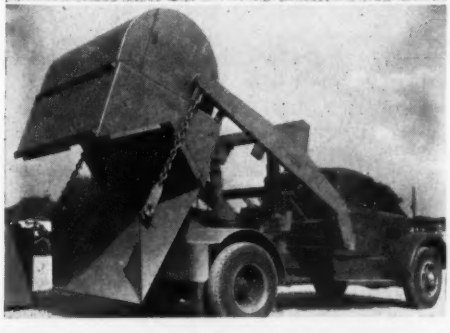
During this past year wash water percentage increased. This was due to insufficient copper sulphate treatment of impounding reservoirs. We did not worry about removing taste and odors, so we let the algae growths develop. We wanted to see how bad the raw water would get and to find out if we would be able to control taste and odor at its worst. Also we hoped that as added turbidity developed it would assist in coagulation. We got the added turbidity but it proved to be the type that didn't help coagulation nor would it settle out. The outcome of this noble experiment was, that although there was no trouble in handling algae tastes and odors, we overloaded the filters, causing shorter filter runs, more wash water to obtain higher rates and longer period of wash. Hereafter, we intend to control the growth and development of algae in our impounding reservoirs with copper sulphate, at least to the point of holding turbidity down to keep the load off the filters, although not as a defense against tastes and odors.

Advantages of Free Residual Chlorine

From our experience it would appear feasible and desirable to experiment with this type of treatment in water from impounding reservoirs; small lakes and ponds which are generally subject to heavy growths of algae; and streams that are not polluted with trade wastes. It seems possible to provide a much more palatable water, free of the usual disagreeable tastes and odors common to such sources of supply. The benefits of free residual chlorine are not confined to water systems with filtration plants, but may be used on any system having a storage reservoir that would furnish a contact period sufficient to accomplish color reduction, oxidation of algae taste and odors, and precipitation of organic matter, iron and manganese. The high disinfection value alone is worthy of consideration by any water works operator. Bacteriological improvement, in our case, probably isn't too conclusive, due to the extremely low counts on our raw supply. However, there is ample evidence concerning the effectiveness of bacteriological improvement in systems where gas formers had previously caused trouble.

With us, break-point over a period of almost two years, has proven itself capable of controlling taste and odor, which is exactly our reason for having undertaken its use. It has given us a method of control that is most economical and convenient. In checking back over the reports we find that during 1943 and 1944 we almost reached break-point: on several occasions a slightly heavier dosage would have done the trick, but we had no realization what was almost happening. There may be many other small plant operators that are, at present, just bordering on the

Is this a Familiar Scene in your town?



It is unfortunate but true, that some towns still permit trash and rubbish to be deposited at the rear of buildings, in alleys, and even on side streets as shown in the scene above. In addition to being feeding stations for rodents and flies . . . breeding spots for disease, it is a very costly method of trash and rubbish collection.

All of these undesirable features can be eliminated at once, and at tremendous savings, with the Dempster-Dumpster System of trash and rubbish collection. Why pay for all the extra time and extra labor it takes to gather and load this scattered rubbish when one man and one Dempster-Dumpster Hoisting Unit can do the work of 4 or 5 ordinary trucks?

The Dempster-Dumpster System comprises one Dempster-Dumpster Hoisting Unit mounted on your truck chassis, and any number of required detachable bodies, of several different designs, and all handled by the same truck unit. Bodies range in size from 4 to 10 cu. yd. capacities, and are placed at convenient points as trash receptacles in the business district, factory areas, schools, residential areas and housing projects.

As these bodies are filled, the Dempster-Dumpster truck hoisting unit makes scheduled rounds picking up, in turn, each loaded body . . . hauls it . . . dumps it and returns the empty to its original location. One man, the driver, handles the entire collection operation.

The neat, sturdy, rubbish bodies are completely enclosed . . . no wind can scatter the rubbish . . . no rats or flies can contaminate it . . . a simple, clean, sanitary and efficient system, and operated on great savings to any town.

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Left Above: Hoisting Unit and Apartment Type Body in carrying position. Center: Truck Hoisting Unit with body on ground. Bottom: Truck Hoisting Unit with body in dumping position. Note how the bottom forms a chute for the rubbish.

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very edge without realizing their position. We don't claim to have this type of treatment completely under control, yet, but we are getting the results and in time will have more of the answers to some of the things that still bother us.

Protecting Your Airport Investment

(Continued from page 26)

rounding an airport. The importance of proper planning and engineering cannot be over-emphasized. The validity or legality of specific airport regulations may well be affected by these considerations.

Model AH District Regulation

AH-1 Districts: Airport Hazard District
The following regulations shall apply in all AH-1 Districts.

A. Uses Permitted
   1. All uses specified in the Use District with which is combined such AH-1 District.

B. Height Limits
   1. No building, structure, tower, pole, wire or other thing shall be erected, constructed, reconstructed, altered, or moved so that any part thereof shall exceed a height of ninety (90) feet.
   2. No trees or other objects of natural growth or any part thereof shall be permitted to exist or grow to exceed said height of ninety (90) feet.
   3. No building shall be erected to a height exceeding the height specified in the Use District in which such building is located.
   4. The exceptions to height limitations contained in the Supplementary Regulations, Section .. shall not apply in any airport hazard district, provided, however, that buildings, structures, or other objects may exceed the Use District height regulations, if permitted by said Supplementary Regulations, to the extent that the maximum height permitted in the AH-1 District regulations exceeds the height specified in the Use District with which said AH-1 District is combined.
   4. (Alternate)
      Where the height limitations set in any AH District conflict with those, including the exceptions thereto embodied in the ordinance, of a Use District, with which it is combined, the more restrictive regulations shall govern.

As many other airport hazard districts as are found necessary may be prescribed in which different height limitations will be imposed. The remainder of the regulations would be similar to those illustrated above.

Milk Losses and Milk Waste Disposal

(Continued from page 23).

milk loss may actually provide a figure in excess of the true loss of income to the creamery since some of the waste products have little monetary value, and are not directly convertible to whole milk loss.

Where drying and processing facilities are available for recovery of waste milk products there is no question as to the direct money savings to be realized. Where they are not available, concentrated wastes such as spoiled whole milk, whey, drippings, etc., can be sold or given to the producers for animal feed. Even though direct financial savings from these methods may be slight, the savings in the indirect costs resulting from waste treatment are so marked as to render such practice mandatory.

Not only should the milk loss be reduced, but the volume of process water should also be reduced as

much as possible. Investigations along both of these lines should be a preliminary to any plan for disposal. Often the savings accomplished will pay for the treatment program in a surprisingly short time.

A typical municipal sewage and milk waste treatment plant for a small community (1500 persons) is shown under construction in Figs. 1 and 2. The primary settling tank, the sludge bed and the pump house are visible. Fig. 3 shows the flow diagram of a plant, not described in the article, where milk wastes were brought directly to a holding tank and filter, after screening and without primary settling. Three methods of recirculation were provided in this plant: From the filter effluent back to the wet well; from the secondary sludge hopper to the primary settling tank, and from the secondary tank effluent to the wet well.

The flow data of the butter and condensed milk plant referred to in the article are shown in Fig. 4. The plant intake for the test day was 92,000 pounds of milk and the 24-hour composite of the waste contained 228 ppm. of BOD. The treatment layout recommended for this plant is shown in Fig. 5. The municipal plant in this case is of the primary treatment—separate sludge digestion type, discharging into a stream of sufficient size to provide adequate dilution. The milk plant wastes are brought directly to a lift station. Ground and flood conditions are such that the holding tank is elevated and gravity flow is controlled by a butterfly valve, which maintains a uniform rate of flow to the high-rate filter. The treated effluent (approximately one-fifth of the flow to the filter) receives final settling in the municipal settling tank and joint usage of the sludge digestion tank and sludge drying beds are contemplated.

Corrective Treatment for Corrosion Control in Baltimore

(Continued from page 21)

to 8.0 with required alkalinity from 40 to 47 ppm. Of these tests, 91% were at pH 7.9. Within these limits a uniform relation between pH and alkalinity did not exist, indicating that the buffer action of compounds other than calcium bicarbonate was a controlling factor in pH adjustment. This deviation has been regularly noted when interpreting the relationship between pH values and alkalinity as found in the water leaving the plant, when compared to that required by the marble test.

It is apparent that without the use of "iron and lime" treatment for the limited period each year, the water has not precipitated a sufficient quantity of calcium carbonate to prevent slight corrosion in the distribution system. This has been corrected by raising the pH value of the plant effluent to 8.1. This control will be continued until active corrosion is checked throughout the system.

Cost, and Value to the Public

Averaging over the 25-year period, the cost of corrective treatment with lime including labor, storage and depreciation of equipment was $0.431 per million gallons of water treated. This is approximately 12% of the purification cost.

The value of this treatment may be summarized by an excerpt from an article published some thirteen years ago (5). The factors stated then apply today and are equally pertinent. They are:

There are now in service many million dollars worth of iron pipe, and it does not seem probable that a metal less corrosive than iron will be used to any extent for large water pipes in the near future. Consequently, if there is to be a substantial reduction in corrosion, it must be brought about by treatment of the water and not by the use of other materials or more durable pipe coverings. The mains are installed; and, except in places where they are too small or have corroded to the extent that they will no longer withstand the pressure, it would not be economy to replace them by another material, regardless of how cheap the other metal might be. Complete elimination of corrosion is not to be brought about by water treatment, but the value of the reduction where the water is fairly corrosive greatly exceeds the cost of treatment.

It is probably safe to say that no neutral water would be satisfactory to all users in any city; and, if it should be treated to remove the constituent that is objectionable to some users, it would become objectionable to others. In considering the desirability of corrective treatment for water, the question should be determined on the basis of the most good to the majority of consumers.

The formation and continued maintenance of a thin film of calcium carbonate on the inside of pipe as a protective coating for prevention of corrosion results in a number of benefits. Any attempt to evaluate the savings to a distribution system resulting from the use of corrective treatment would be futile without exact cost data extending over a long period of time, because of the many factors not chargeable to corrosion. It would, however, be a serious matter to permit the corrosion and pitting of the many miles of mains in our cities, which, for Baltimore and vicinity, are valued at over $30,000,000.

The corrosion of mains causes the formation of incrustations and tubercles that greatly increase friction losses and reduce their carrying capacity. Small mains may become almost useless unless they are occasionally cleaned. If mains are cleaned and the water not corrected, corrosion activity is increased because of the exposure of fresh iron surfaces, and it will be only a few years before they again require cleaning. The many buildings connected to water supplies are equipped with expensive piping systems of wrought iron, steel, and galvanized iron, which are more readily attacked by corrosive water than cast iron. While it is not possible to determine accurately the cost of corrosion in such systems, it is very great where no provision is made for prevention.

An engineering project is often decided exclusively on the basis of cost. The one estimated to be the cheapest is considered the best. Such decisions omit the source of important factors such as a reasonable assurance of security, a satisfied public, freedom from complaint, and reduced maintenance costs. Should the "soft water" cities omit corrective treatment, the familiar "red water trouble" would cause innumerable complaints from householders regarding the staining of clothes, bathroom fixtures, etc. In addition to the direct replacement cost of pipe due to corrosion, a host of indirect costs would accrue, occasioned by damage to plaster, furniture, and other goods. . . . It is, therefore, believed that corrective treatment with lime produces a water of the most economic value to the most users.

Acknowledgment is made by the assistance given by George G. Dobler, Senior Analytical Chemist, in performing the laboratory work and of the criticism of the manuscript by S. E. Edwards, Senior Assistant Superintendent of Water Treatment. Information serving as the basis for this paper was obtained from the official records of the Bureau of Water Supply, Department of Public Works, through the courtesy of Nathan L. Smith, Chief Engineer, and Leon Small, Water Engineer.

Literature Cited

(1) Baylis, John R., J. Amer. Water Wks. Asso., 9; 408 (1922).
(2) Hall, Frank E., Ibid., 13; 15 (1934) 27; 1199 (1935).
(3) Heyer, von, Tillmans, and Heubelin, "die Unterschung und Bierteilung des Wassers und Abwarsers." 4th ed. p. 40, Okmuller, U. Spitta.
(4) Hopkins, Edw. S., Ind. Eng. Chem. 25, 1050 (1933).
(5) Hopkins, Edw. S., Armstrong, J. W. and Baylis, J. R., Ibid., 26, 250 (1934).
(6) Whitman, G. W., Russel, R. P. and Altieri, V. J., Ibid., 16, 665 (1924).

PUBLIC WORKS DIGESTS

Sewerage

Water Supply

Highways and Airports

This section digests and briefs the important articles appearing in the periodicals that reached this office prior to the 15th of the previous month. Appended are Bibliographies of the principal articles, in which the articles in each periodical are numbered consecutively throughout the year, beginning with our January issue.

The letter and number at the end of each item refer to those used in the Bibliography. Numbers not found in the current Bibliography will be found in the one published the previous month.

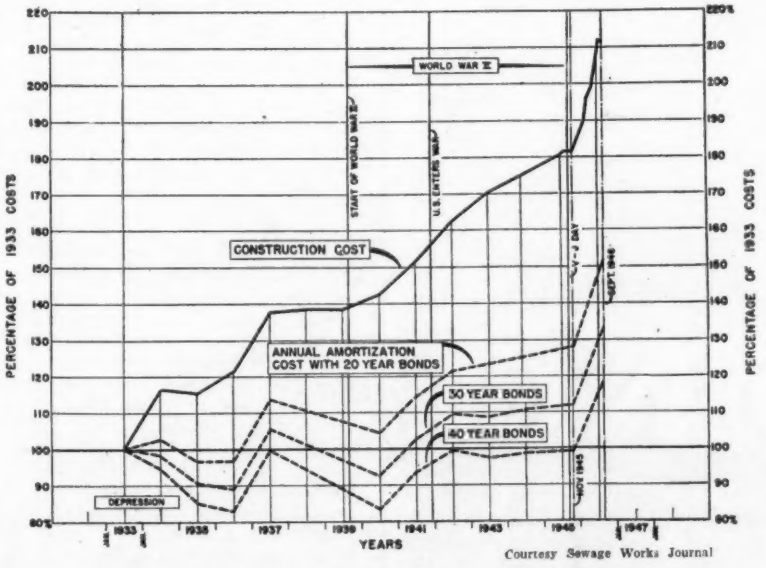
The Sewerage Digest

Financing Sewage Works

The cost of constructing sewage facilities in a municipality should be stated in terms of annual debt service requirements rather than in terms of construction costs. While construction costs in 1946 were 111.6% above the 1933 level, interest rates on municipal bonds are lower than ever before, with the result that the amortization cost of 30 yr. bonds issued today is only 32.6% greater than would have been the cost for bonds issued in 1933 to provide funds for the same work at the then-existing prices.

A municipality may raise funds for constructing sewage works by issuing general obligation bonds, by special assessments or special assessment bonds, current revenue from existing sources, revenue bonds or certificates, creation of a special organization or independent corporation, by temporary loans, by a combination of two or more of the above. Or it may grant a franchise to a privately owned sewer company, but this is not recommended. Good financing indicates that money should be borrowed and bonds issued only for funds which cannot be raised in other ways. Therefore if any cash on hand or excess revenue is available to help defray the cost of construction, this should be used to reduce the amount of the bond issue and the annual debt service. One plan is to assess the sewers themselves against the abutting property owners, and finance the cost of treatment facilities, pumping stations, outfall sewers, etc., through general obligation bonds.

If the system is financed through revenue bonds, a proper system of changes is necessary. Six methods are suggested: 1—A service charge plus metered water consumption. 2— Graduated schedule based on water consumption. 3—Combination of assessed valuation and water consumption. 4—Graduated charge on basis of water consumption plus an additional charge based on the character of sewage or industrial waste. 5—Charge based on floor area or footage of property served. 6—A rental based on the number of employees in an industry plus a water consumption charge. The trend today is toward the use of revenue bonds and the establishment of sanitary districts, commissions or authorities.[C38]



Courtesy Sewage Works Journal

Relation between construction and annual amortization costs.

Utilization of Organic Substrates by Activated Sludge

This article discusses the removal from solution, oxidation, and conversion to protoplasm by activated sludge of 36 organic substances, including sugars, alcohols, aldehydes, organic acids, amino acids and miscellaneous compounds; eliminating those compounds in each class not readily attacked by activated sludge. After 24 hr. of aeration with activated sludge, from 90 to 99% of the compound will be removed from solution, and an average of 13% of the carbohydrates, 30% of the alcohols, 42% of the amino acids and 50% of the organic acids will be oxidized; while there will be converted to protoplasm (organized sludge) 65 to 85% of the carbohydrates, 52 to 66% of the alcohols, 32 to 68% of the amino acids and 10 to 60% of the organic acids. This explains why there is such a stimulation in sludge production when large quantities of carbohydrate wastes are added to the sewage. Normal activated sludge, when subjected to an increase of carbohydrate feed, will quickly become acclimated and, because of adsorption and assimilation at rapid rates, will produce enormous quantities of sludge with a low ash content. This

should be an important consideration in the design of plants where this condition is likely to occur due to seasonal discharges of cannery wastes, corn or sugar products or similar materials.[C41]

Protecting Underground Water

The 3,600,000 population and thousands of industries located in Los Angeles County, Calif., obtain a large part of their water supply from underground storage basins in water-bearing gravels which underlie the western third of the county to depths of from 100 to 1500 feet. It is estimated that the first 100 ft. of these deposits store 3,689,000 acre-feet of water. This water is subject to pollution from the ground surface above, through cesspools, leaching pits and polluted streams. The county is well, although not completely, sewered; and the most serious problem is that due to industrial wastes, especially strong acids and alkalis from plants manufacturing plastics, hormones, weed killers, etc., which are excluded from the sewers because of their injurious effect upon them or upon the treatment plants. One plant which manufactured a weed killer produced a small amount of waste water which had been used for cleaning out containers, but within 17 days after it began operation the 11 wells supplying water to a community of 25,000 people 15 miles away were out of operation because of the toxic effect and medicinal odor imparted by the chemical. Although this plant was shut down a year ago after less than 30 days' operation, the water still must be treated with chlorine dioxide.

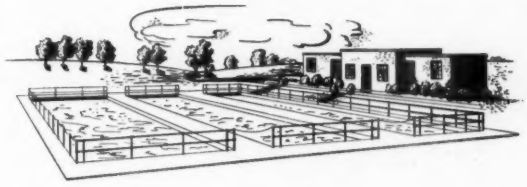
Legal provision for control of domestic wastes is adequate, but the problem of industrial wastes is a more difficult one. Chemical pollution can do its damage so quickly that *preventive* legislation and control are essential. The County Board of Supervisors, after consulting water companies, industries, property owners, the Chamber of Commerce and others, has recently adopted an ordinance aimed to prevent creation of a nuisance, danger to public health and pollution of water supplies in a manner which will attract industry rather than drive it elsewhere. If a new industry plans to locate in the area, it must advise the county officials of the waste disposal problems and requirements; the county engineer and health officer must approve the plans for waste disposal; and after the plant is put in operation there will be periodic maintenance inspections by the county health officer and county engineer.[C43]

Scum in Digesters

Scum in a digester is a problem when it interferes with uniform gas production, plugs pipe outlets and stops the normal overflow, interferes with the withdrawal of tank contents, or when its volume is so great as to reduce materially the available digestion capacity. These troubles are caused by grease and oil products, by mat-forming materials from industrial plants, by miscellaneous indigestible materials such as matches, rags, etc., and by gas-buoyed sludge.

The best method of control of scum produced by industrial wastes is to keep the scum-forming materials out of the sewage plant, with the cooperation of the industry. But this often is impossible, and treatment at the plant is necessary. Grease and oil scum often can be wholly or partly eliminated by raising the temperature of the digester to 95° or 100°. If the heat does not penetrate the scum, circulate the digester contents from the bottom to the top, discharging it above the scum; or inject steam or hot water into the top. If the scum consists largely of indigestible materials it should be removed at intervals. If the scum consists of gas-buoyed sludge, it can be made to settle by breaking it up by agitation. If the digester has a submerged roof, a scum breaker consisting of alternate fixed and moving fingers which sweep the submerged underside of the roof has proved successful. If the roof is not submerged, a mixer can agitate the entire scum, which is difficult with any pumping arrangement.

Super-clean air extends life and efficiency of diffuser plates



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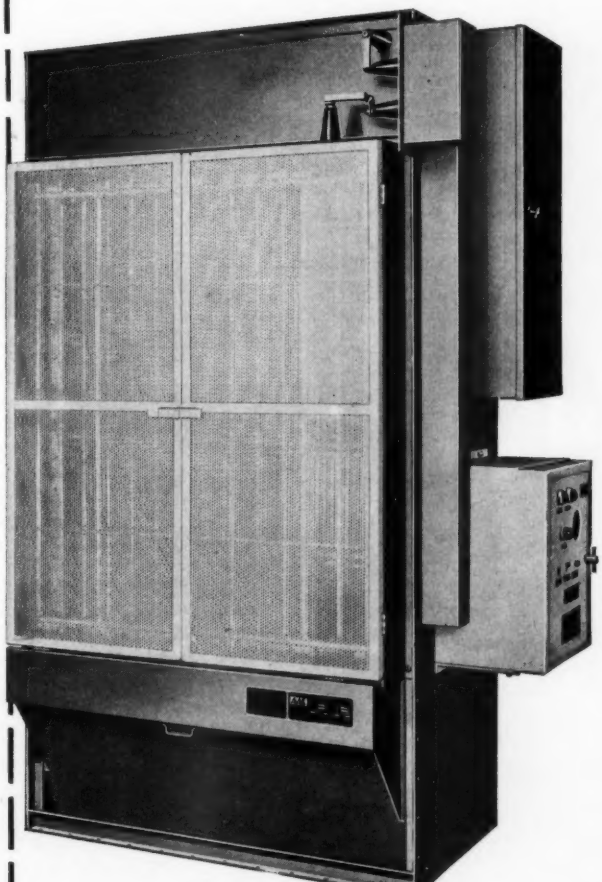

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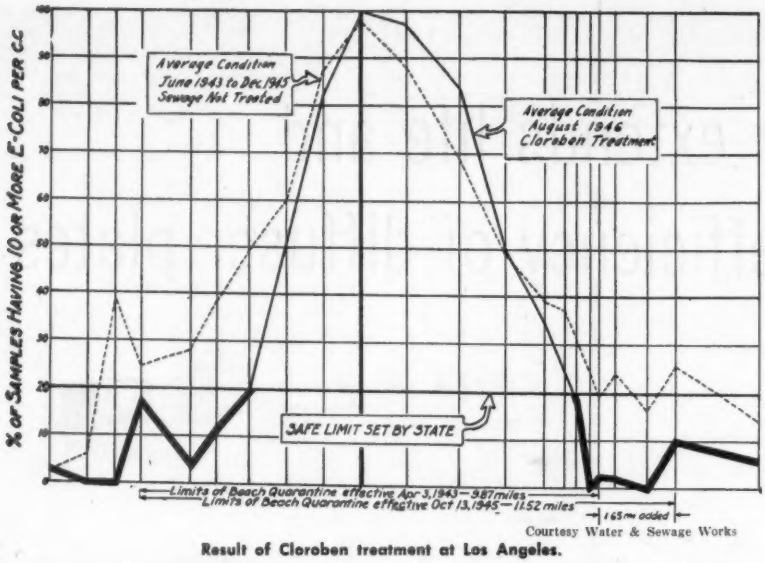

Courtesy Water & Sewage Works

Result of Cloroben treatment at Los Angeles.

Capacity of the digester is important. Plants with a capacity of less than 25 to 30 days, based on the volume of the raw sludge feed, almost invariably have trouble with scum or supernatant or both; while those with capacities of 50 or 60 days seldom have serious scum or supernatant problems. Another desirable design feature is a scum draw-off by which the scum can readily be removed directly.

Discussing this paper, Harry E. Schlenz said that the digester is the ideal place to dispose of grease and scum. They should be kept in intimate contact with the digester liquid by either positive submergence or recirculation. In recirculation, no appreciable force of discharge is necessary, but the upper 2/3 of the liquid should be recirculated in 24 to 48 hr. In a number of cases the addition of relatively small amounts of an ammonia nitrogen compound has caused the rapid digestion of heavy scum accumulations.[C39]

Cloroben Treatment of Sewage at Los Angeles

Because pollution of water of the Pacific Ocean by the effluent from the Hyperion sewage plant of Los Angeles rendered bathing unsafe in beaches along the cost north and south from the outlet, the state board of health in 1943 declared a quarantine against all beaches where more than 20% of samples of the water showed 10 or more E. Coli per c.c. This applied to 9.87 miles of the coast, which was extended to 11.52 miles in 1945. Efforts made by the city had resulted, by August, 1946, in reducing the quarantined distance by 2.15 miles in one direction and 2.37 miles in the other, or about 40%; although conditions were not much improved for two or three miles nearest the outlet.

The city experimented with chlorine, bleaching powder, DDT, salts of heavy metals, and several organic compounds. One of the last, cloroben, gave the most favorable results. Applied to the sewers in the city at the rate of 1.0 ppm and given a contact time of 5 to 9 hr. before reaching the outlet, it reduced the bacteria count of the sewage by 50 to 90%. When diluted in 100 volumes of sea water and allowed

When you need special information—consult the classified READERS' SERVICE DEPT., pages 93-97

an additional 3 to 5 hr. contact, the reduction was further increased.

Another important effect of the cloroben was that it inhibited the formation of hydrogen sulfide by checking the growth of the organisms that produce it. Also there is an unexplainable reduction in the humidity of the air in the sewer. It also tends to dissolve greases and slimes in the sewer.[G17]

Treating Ground Garbage With Sewage

Eleven years ago Indianapolis, Ind., began treating ground garbage with its sewage, and two or three years later Findlay, O., and Marion, Ind., adopted this procedure. A study of these three plants forms the basis of this article. Reference is made also to the use of household grinders, 400 or 500 of which are in use in Schenectady, N. Y. One problem is the "grit" (non-organic matter) in the garbage. At Findlay, there was an average of 1.5 cu. ft. of grit per m.g. of sewage before garbage was added and 2.7 cu. ft. afterward. This should be removed before the garbage goes to the digesters.

It is indicated that the garbage of a community will average 2 tons per m.g. of sewage. When this amount is added to the raw sewage, the increase in suspended solids will be approximately 25 to 35%, and in B.O.D. 18 to 26%, depending upon the solids in the raw garbage. The increase in strength of primary settled sewage after 2 hr. settling will be approximately 10 to 14% in suspended solids and 11 to 16% in B.O.D. Garbage matter is oxidized by activated sludge, and probably by all secondary processes, as efficiently as is sewage material. Increased plant secondary units must be based upon the increased garbage load in the primary effluent. For digestion of primary solids and garbage, 5 cu. ft. per capita digester capacity is needed, while the capacity for primary and secondary sewage solids plus garbage should be 9 cu. ft. The most economical means of dual disposal appears to be by direct addition of garbage to the digesters, unless central grinding stations are used. The cost of disposal of garbage at the sewage plant will be between 10 cts. and 50 cts. per ton.

Findlay plans ultimately to introduce the garbage at sludge concentration units, where the ground garbage slurry will be mixed with the sewage sludge for conditioning before discharge to digestion units; this conditioning to include concentration, neutralization, preheating and (of prime importance) removal of extraneous matter.[C42]

Packinghouse, Brewery And By-Products Coke Wastes

There is little difference, biologically, between packinghouse wastes and sewage except that the former are fresher, higher in grease, with a relatively higher ratio of carbon to nitrogen and

a somewhat higher temperature. They can be treated most successfully by multistage filters or, if diluted, by activated sludge. However, for small plants chemical precipitation may be the only feasible process because of the expense and difficulty of control of biological processes. Studies are being made of vacuators, pressurators, vibrating screens, grease basins, aerated grease skimmers and special equipment for removal of solids, to aid in reducing the wastes to minimum strength and degree of variation.

Brewery wastes from one barrel of beer are equivalent to the sewage from 19 persons based on BOD. In Chicago, grains and yeast are collected from practically every brewery by companies which dry the materials and sell the product as feed, source of vitamins or proteins, or medicinal products. Where this is done, the remaining wastes are treated with the city sewage without difficulty. Even without salvage, brewery wastes are a much less troublesome problem than other fermentation wastes, such as those from the manufacture of yeast, alcohol or wine.

By-products coke plant wastes are chiefly objectionable because of the chlor-phenol tastes, but these can be eliminated with activated carbon, ammonia-chlorine treatment, breakpoint chlorination, or chlorine dioxide. Phenol can be removed, if necessary, by extraction or Koppers plants, one Chicago plant averaging 97.5% removal. Treatment of these wastes in biological sewage treatment plants is quite successful, but requires additional air and tankage in activated sludge plants or area in trickling filters.[C44]

Ferric Sulfate by The Autoxidation Process

This is a method for the cheap local production of ferrous sulfate, ferric sulfate and dilute sulfuric acid through the simultaneous oxidation of sulfur dioxide and ferrous sulfate in the presence of finely divided air. The plant at Phoenix, Ariz. consists of a pressure sulfur burner, a reaction cell of the air-diffuser type, and a scrap iron reaction tank. (Any available type of iron scrap may be used.) The cost is $19.19 per ton of ferric sulfate or $9.58 per ton of copperas. Compared to ferric chloride, while slightly more ferric sulfate than ferric chloride is required for equivalent results, the amount of chlorine needed per pound of metallic iron would cost over 5.6 cts., the sulfur would cost only 1 ct. However, the process is not recommended for a small town where skilled operators are not continually on duty.[C45]

Why the Army Favors Sanitary Fills

The Army favors sanitary fills for camps because of low cost of initial construction and of operating; large increases in daily quantity of refuse are disposed of without large additional expense; they dispose of all types of refuse; if correctly operated they are not unsightly and do not create odors; they reclaim low areas; eliminate the need for operating open dumps; can be put into operation in a few days; and the equipment can be moved to another post when a camp is deactivated. They are not satisfactory unless a suitable site is selected, the project is properly engineered and operated according to approved practices.[P16]

Los Angeles Sewage Works

With some $9,000,000 of contracts under way, the Los Angeles sewage disposal program, estimated to cost more than $25,000,000, centers around a 245 mgd high-rate activated sludge treatment plant, with provision for 350 mgd dry weather peak and 420 mgd wet weather peak. The plant will comprise stone removal by baskets; coarse screening; comminution; grit removal; primary sedimentation; high-rate activated sludge treatment (aeration and sludge recirculation); secondary sedimentation; pre- and post-chlorination when required; primary and secondary sludge digestion; elutriation; vacuum filtration; sludge drying; and gas recovery for heat and power purposes. Except for sludge digesters and aerators, all plant units will be covered, making

a total enclosed area of some 900,000 sq. ft. Sludge will be digested, elutriated, filtered and dried for sale as fertilizer.[E6]

Incineration Displaces Landfill

New York City has returned to waste disposal by incineration after ten years' practice of sanitary land fill. The reasons include civic protests, disappearance of available areas, and need for restoring adequate collection which had been sacrificed for long-haul trucking. Landfill cost 9 cts. per cu. yd. and incineration 33 cts., but the cost in wear and tear of trucks, haulage and time more than offset the difference. The equipment and manpower occupied in long hauls to distant fills can now be used for giving more efficient collection service.[J8]

Tree Roots In Sewers

Ridgewood, N. J., found it very desirable to eliminate tree roots from its sewers, and uses copper sulfate for this purpose. Applying it in manholes helped, but this was supplemented by applying it in the house services themeslves, killing the roots in them also. Two or three pounds of copper sulfate crystals were dissolved in a toilet bowl in each house (not in fixture traps, where it might corrode) and flushed into the sewer. This was done during periods of low flow of sewage to obtain a relatively high concentration. This proved effective, and apparently has had no ill effect on the trees.[J7]

Bibliography of Sewerage Literature

C *Sewage Works Journal*

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38. Financing Sewage Works. By Francis S. Friel. Pp. 379-404.
39. Scum Control in Digesters. By R. S. Rankin. Pp. 405-414.
40. Effect of Phosphates on Sludge Digestion. By Willem Rudolfs and G. W. Stahl. Pp. 415-422.
41. The Utilization of Organic Substrates by Activated Sludge. By O. R. Placak and C. C. Ruchhoft. Pp. 423-440.
42. Ground Garbage—Its Effect Upon the Sewer System and Sewage Treatment Plant. By S. L. Tolman. Pp. 441-463.
43. Protection of Underground Water from Sewage and Industrial Wastes. By Arthur Pickett. Pp. 464-472.
44. Packinghouse, Brewery and By-products Coke Wastes. By F. W. Mohlman. Pp. 473-477.
45. Various Applications of the Autoxidation Process. By Dario Travaini. Pp. 478-486.
46. Operation of the Tallmans Island Sewage Treatment Plant at New York City. By Henry M. Rath. Pp. 488-494.
47. Chemical Treatment of Los Angeles Sewage to Retard Slimes and Sulfides. By A. A. Appel. Pp. 494-498.
48. Coal Tar Paints for Sewage Works. By M. F. Abrams. Pp. 505-509.
49. Possible Uses of DDT Against Insect Pests Encountered in Sewage Treatment. By Elton J. Hansens. Pp. 513-519.

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23. Screening and Grit Removal in Sewage Disposal. By J. Moore. Pp. 271-272.

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24. Construction of East Hull Outfall Sewer. By G. E. Marshall. Pp. 281-282.
25. Screening and Grit Removal in Sewage Disposal. By J. Moore. Pp. 285-286.

E *Engineering News-Record*

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6. Biggest Sewage Works in the West. Pp. 48-51.

G *Water and Sewage Works*

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18. The Determination of Cyanides. By T. R. Haseltine. Pp. 187-191.
19. Determination of B.O.D. Values by Chemical Oxidation. By George A. Rhame. Pp. 192-194.

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P *Public Works*

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17. Solving Sewage Treatment Problems at Ridgewood, N. J. Pp. 25-26.
18. Trickling Filters: Aero Filters. Pp. 29-34.

The Waterworks Digest

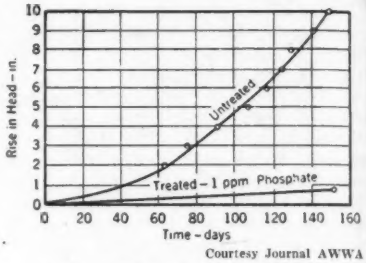
The Load Factor In Water Rates

Most systems of water rates include either the service charge or the minimum charge for both residential and industrial consumers, the commodity rate varying with the quantity consumed similarly for both classes of consumers. But the ratio of peak consumption to average consumption is much greater for residential than for industrial consumers, and this difference should be reflected in the fixed charge part of the rate. This the author thinks is best accomplished by using for residences a minimum charge based upon the meter size, plus a commodity rate uniform for all consumption rates; and for industries, a service charge based on meter size, plus commodity rates varying with the consumption rates. As an illustration, he suggests for residential rates a uniform charge of 25¢ per 1000 gal., plus a minimum charge of 75¢ per month for a 5/8" meter, up to $2.25 a month for a 1½" meter; and for industrial rates, 25¢ per 1000 gal. for the first 25,000 gpm, 12¢ for the next 225,000 gpm, and 9¢ for all over 250,000, plus a service charge varying from 75¢ per month for a 5/8" meter up to $18.00 for a 6" meter. The resulting rates probably would not differ greatly from those now in force, but this system furnishes a logical defense of them.

One advantage of the service charge is that it discourages meter oversizing and encourages storage of water on the property to meet peak loads; also discourages multiple metering.[G27]

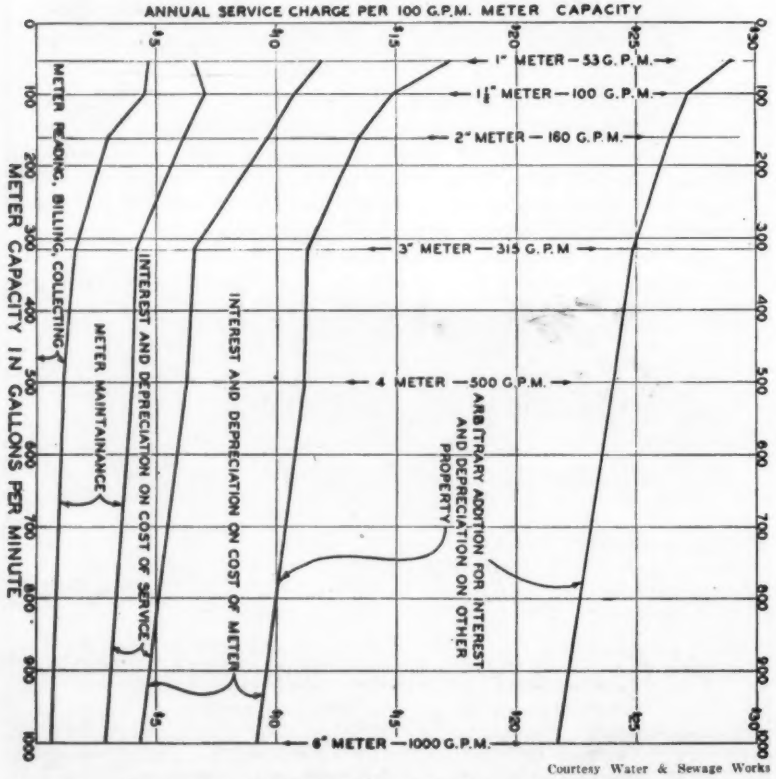
Uses of Calgon In Water Treatment

Calgon is one of the sodium phosphate glasses. It deposits a protective film on metal surfaces if present in water in concentrations as low as 1 or 2 ppm, thus controlling corrosion. Agitation of the water accelerates the rate of deposit. Heat increases the protection given. Calgon also prevents the precipitation of dissolved iron from well water if there be present 2 parts of phosphate for each part of iron in the water. The adsorption of glassy phosphate on the particles of iron oxide tends to keep them separated and prevent their growth to such size that they will cause noticeable discoloration. This is akin to the action of corrosion control, in which the formation of the protective film is due to the adsorption of this phosphate upon iron or iron oxide. It is vitally important that the glassy phosphate be added to the water before the iron can oxidize through either exposure to air or treatment with chlorine. It also greatly reduces tuberculation. In tests made at Lynchburg, Va., treatment with 1 ppm of the glassy phosphate practically stopped tuberculation as well as corrosion.[A82]



Courtesy Journal AWWA

Tuberculation tests at Lynchburg.



Courtesy Water & Sewage Works

Component parts of service charges based on meter capacities.

Repairing a Concrete Reservoir

Halifax, N. S., in 1913 built, in connection with its water supply, a concrete reservoir 160 ft. in diameter and 25 feet deep, with the wall 3 ft. thick at the bottom tapering to 18" at the top, with two concentric layers of reinforcement 4" to 6" from the inside and outside faces, 88 horizontal 1¼" bars in the bottom 11 ft. Examination in 1945 showed the roof on the point of complete failure, and a band 4 ft. wide extending completely around the inside wall so badly eroded that the reinforcing was exposed, and fully 50% of the exterior wall area was heavily spalled,, large sections having fallen off exposing the reinforcement, probably due to frost action and the dense mass of reinforcement which acted to form a cleavage plane between the outer concrete and the main mass. The reservoir has been repaired, the walls raised 4 ft. and a prestressed concrete dome roof built. The entire wall surface was chipped with pneumatic tools, cracks and construction joints cut out, and the wall sandblasted; anchors were set in the concrete 30" apart and wire mesh secured to them. The surfaces were then thoroughly water blasted and gunite shot on in several successive layers, the final one being screeded with straight-edges and wood-floated. To carry the thrust of the 164 ft. prestressed dome roof, which

is 2½" thick, a main ring was constructed, prestressed by winding around it 42 miles of high-tensile wire, under a stress of 140,000 psi, in five continuous spirals, with a thin layer of gunite between consecutive spirals and a 1" layer of gunite on the outside.[A74]

Care of Water Works Equipment

The Los Angeles water system operates 522 cars and trucks ranging from 10-ton trucks to ½ ton trucks and jeeps; also air compressors, pumps and other various equipment. To keep all this in condition it employs 6 inspectors, 46 garage attendants, 45 auto machinists, 11 heavy equipment machinists, and 10 battery men, metal men, upholsterers, painters and dispatchers. Cars and trucks are inspected monthly, and if repairs are needed costing less than $50 for cars or $100 for trucks, they are made at once. If the repairs would cost more than this, the records are examined to learn if the repairs are warranted. Heavy equipment machinists repair caterpillars, cement mixers, trenchers, compressors. Oil in cars and trucks up to 1½ tons is changed every 2,000 miles, in 1½ ton or heavier trucks every 1,000 miles, in tractors and other heavy movable equipment after 48 hr. of operation. For this maintenance, service trucks are used, equipped with air compressor, force-feed lubrication grease guns, gasoline tanks, etc.[A75]

Standardization of Hydrants, Valves and Meters

The value of standardization of dimensions, threads of hose outlets, direction and number of turns to open gate valves, meter repair parts, etc. seems self-evident. It is difficult for a city to secure this by confining its use to only one make, since the law may require competitive bidding, the maker may go out of business or discontinue the pattern selected; and most cities already have several makes installed. Toledo has in use valves of 20 different manufacturers, 15 different makes of meters and 22 different types of fire hydrants, about one-third of each of which are no longer being made. It is highly desirable that manufacturers standardize certain dimensional and mechanical features which would in no way alter their own particular advantages over competitors.[A73]

Maintenance Of Standpipes

The Portland, Me., Water Company maintains 14 standpipes. It has never had a leak or a failure, which is attributed to "a program of constant inspection and consistent cleaning and painting at least once in every five or six years." The average cost per year for the three oldest has been: $130 for a 602,000 gal. tank 31 yr. old; $120.83 for a 653,000 gal. tank 28 yr. old; $81.70 for a 360,000 gal. tank 27 yr. old.

The Central Maine Power Co. has considered building tanks of 10% nickel clad steel or a 20% stainless steel clad metal, which should be good for an indefinite period with only outside painting, but cost three times as much as a standard type. "In the not too distant future undoubtedly there will be many such installations of a non-corrosive clad metal." Another idea considered was coating the interior with reinforced gunite, but this is too expensive. This company has adopted oxyacetylene flame cleaning and dehydrating for burning off the old paint and conditioning the surface before painting. After flame cleaning, they wire brush to remove all scale, burnt paint, etc. and apply the paint while the steel is still warm and free from moisture. They prefer brush painting to use of a spray gun, since the latter requires expert thinning of the paint and use of the gun. When repainting over old paint, it should be thoroughly wire brushed, then washed with turpentine or paint thinner to remove dirt film. The Pittsburgh-Des Moines Steel Co. tested 196 paints and coatings, and found the best to be a gray synthetic gum vehicle applied over a chromate primer; aluminum mix paints being given the next four highest ratings.[V6, 7 & 8]

Metering in Honolulu

By the end of 1930 Honolulu was completely metered, but there was 25.7% unaccounted-for water. A system of meter maintenance was inaugurated in 1931 and by the end of 1946 the unaccounted for water was reduced to 7.8%. At present there are 28,460 meters, of which 91.3% are ⅝" and ¾". About half are of the old open gear type and the others of the newer type with oil-enclosed gear trains. According to the present system, all meters are tested on an average of once in 6 yr. From 4 to 6 meters are brought to the shop daily because of non-registration and about 20 others for scheduled testing.

Cleaning, testing and repairing methods are similar to those employed elsewhere; except that the parts are no longer immersed in a cleaning solution, because the water is of such quality that there are no deposits of incrusted material and soap and water and a stiff brush do the job.

An endurance test rack has been installed in which 20 ⅝" meters of various makes run continuously at 5 gpm and are read and tested every 3 months. Some interesting information has been obtained from this test.[F40]

Watershed Research

A research in management of water resources is being conducted by the Southeastern Forest Experiment Station of the U. S. Forest Service, using as a work center the Coweeta Experimental Forest, a drainage area of some 4,000 acres in western North Carolina. In this are 28 independent gaged drainage areas, 16 of which are being used experimentally and 12 held as controls. Continuous measurements are being made of

1. *Rainfall:* 13 recording gages, 63 standard (non-recording) gages
2. *Runoff:* 29 recording stream gages (Cippoletti weir and deep notch control)
3. *Ground Water:* 21 recording well gages, 19 non-recording wells
4. *Temperature and Humidity:* 5 recording hygrothermographs
5. *Wind:* 1 recording anemometer at 8-ft. height, 1 recording anemometer at 2-ft. height.
6. *Evaporation:* 1 U.S. Weather Bureau Standard evaporation pan.

In addition, quality determinations are made of water, moisture and structure analyses of soils are studied, and soil and water temperatures.

With these data, studies are being made of the utilization of water by trees, of the effects of various uses of the land, and of upstream engineering control—ponding basins and other minor engineering structures. Studies are being made of the effects of permanent cutting of major vegetation, of temporary cutting of this, of cutting of stream-bank vegetation, of mountain agriculture, of woodland grazing, of

forest fires, and of logging. It has been found that transpiration by vegetation accounts for 17″ to 22″ of water a year. Grazing cattle trampling the ground decreased the porosity of the surface soil 10%. Logging operation increased the turbidity of the run-off 15 to 20 times, but much of this could be avoided by well designed skid trails and access roads.[A68]

Watershed Cover and Runoff

The type of vegetative cover on a watershed significantly affects the quality and quantity of water supply. A watershed completely covered with an undisturbed forest is the most desirable type of cover; the forest floor is covered with a deep layer of absorptive vegetable matter, the soil is interlaced with roots and abounds in worms, larvae, bacteria and other forms of organic life; all of which makes it ideal for absorbing, holding, storing and filtering water up to 50% of its total volume. Forest mineral soil does not freeze so quickly nor so deeply as open field soil. Snow lies in the forest longer and melts more slowly.

The forest should be so lumbered as to remove mature trees and leave choice unripe ones. Virginia's State Forest Service will, upon request of a landowner, work over a timber tract, blaze and stamp with a seal the trees that should be cut, and measure the merchantable volume, at a charge of 25¢ per 1,000 fbm.[A69]

Accident Prevention

Accident prevention requires a study of all working areas to detect physical accident hazards; a thorough study of all operating methods and practices; education, instruction and discipline to minimize "human" accident hazards; and a thorough investigation of every accident and doing whatever is necessary to prevent recurrence, including mechanical improvements, better supervision, and instruction of workmen. Analyze the agency, type, and unsafe condition, act and personal factor involved in each accident. If packaged materials or other objects that must be lifted weight over 50 lb., mechanical lifting and conveying devices are desirable; strains accounted for 16% of all reported accidental injuries occurring on the properties of the American Water Works & Electric Co. in 1946. Use of clear plastic face shields, or at least goggles, should be required of all workmen handling melted lead and hand-cutting cast-iron pipe.[A70]

Bibliography of Waterworks Literature

A *Journal, American Water Works Ass'n June*

74. Reconstruction of the Halifax High Service Reservoir. By R. M. Doull and J. D. Kline. Pp. 503-514.
75. Care of Power Tools and Equipment. By D. M. Van Norman. Pp. 515-519.
76. Mutual Aid Program for Peacetime. By Earl Devendorf. Pp. 520-526.
77. Legislative Protection for Indiana Ground Waters. Pp. 527-528.

78. Industrial Use of Streams. By L. L. Hedgepeth. Pp. 532-538.
79. Survey of Unaccounted-for Water in Minnesota. Committee Report. Pp. 539-542.
80. Office Procedure in a Small Water Works. By F. G. Gedge. Pp. 543-546.
81. Comparative Study of Swedish and American Water Treatment Practice. By Harry L. Schein. Pp. 547-551.
82. Corrosion Control With Calgon. By Owen Rice. Pp. 552-560.
83. Bactericidal Properties of Chlorine Dioxide. By G. M. Ridenour and R. S. Ingols. Pp. 561-567.
84. Analysis of Pipe Flow Formulas in Terms of the Darcy Function *f*. By Leo Hudson. Pp. 568-594.

D *The Surveyor*
May 23

3. Construction of the Darwell Impounding Dam and Aqueduct. By Sidney Little. Pp. 267-269.

E *Engineering News-Record*
May 29

14. Water Pipeline on the Desert Floor (Australia). Pp. 63-65.

F *Water Works Engineering*
May 14

36. Operation and Maintenance Practices at Wilkinsburg, Pa. By William H. Lang. Pp. 516-518, 544.
37. Dredging of Sediment From Belmont Reservoir. By Joseph E. Gill. Pp. 519-520.
38. Selecting Meters for Customer Use on Water Demand Basis. By Sam F. Newkirk, Jr. Pp. 525-526.
39. Freez-Seal Method of Repairing Service Pipes. P. 529.

May 28

40. Metering and Meter Field and Shop Practices in Honolulu. By Edward J. Morgan. Pp. 576-580.

G *Water and Sewage Works*
May

27. Something New in Water Rates. By Melvin P. Hatcher. Pp. 157-164.
28. The Flooding of the Lea Bridge Works of the Metropolitan Water Board of London. By Frank Wood. Pp. 172-174.

P *Public Works*
June

17. Modernizing a Pumping Station Saves Money. By H. F. Fetters. Pp. 19-20.
18. Chromate Corrosion Inhibitors in Air Conditioning Waters. By Marc Darrin. Pp. 27-28.

V *Maine Water Utilities Ass'n Journal*
May

6. Standpipe Protection. By Arthur F. Burke. Pp. 47-50.
7. Protective Coatings for Standpipes. By Alfred F. Howard. Pp. 51-55.
8. Maintenance of Standpipes. By Fred J. Reny. Pp. 56-58.

Milk and Food Sanitation Practice

This is a new book by H. S. Adams of the School of Public Health, University of Minnesota. It tells how to plan and administer a milk control program; rather special emphasis is laid on the educational phases of the work, and a plan and outline for classes of instruction for milk and food handlers are included in the book. This is published by the Commonwealth Fund, 41 East 57th St., New York 22, N. Y.

Paul Weir Made General Manager of Atlanta Water Works

Paul Weir, well and widely known in sanitary engineering circles, has been made General Manager of the Atlanta, Ga., Water Department effective July 1, 1947. He has been with the water department for nineteen years, serving successively as laboratory technician, superintendent of filtration and assistant general manager. He was educated at Georgia Tech. He has been a leader in water purification in the southeast; in 1940 was given the Fuller Award for outstanding engineering leadership in the southern states; and in 1941 the Goodell Prize for scientific research on corrosion control and pipe linings.

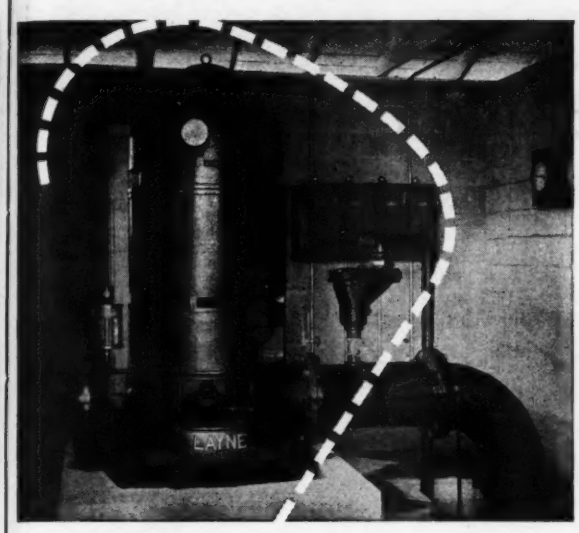
John A. Goetz Dies

John A. Goetz, for many years associated with the city of Mattoon, Ill., died recently. He was superintendent of Water Systems and of Sewers and Sewage Treatment at the time of his death, and was active in the Illinois Section of the AWWA and the Illinois Society of Professional Engineers.

Two Motion Pictures

"Pulling for Profits" is a 20-minute film, available in both 35 mm and 16 mm sizes, which shows the uses and values of the Detroit Automotive Products Corporation's "no-spin" differential for trucks.

"International diesel power" is a 2-reel, 22-minute, black and white 16 mm sound motion picture which is available from the International Harvester Co., 180 No. Michigan Ave., Chicago 1, Ill.



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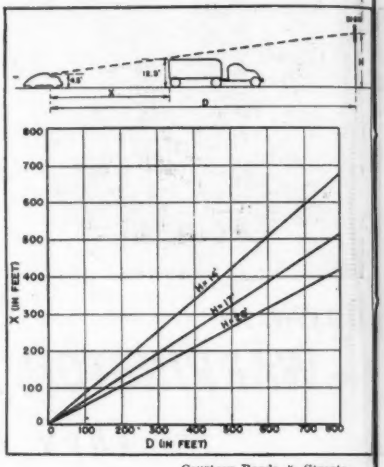
The Highway and Airport Digest

Origin and Destination Traffic

In Leeds a major cause of congestion in the center of the city is traffic that passes through it without stopping. To remedy this condition it was proposed to construct a circle road circumscribing this central area to serve as a route for such through traffic. In planning this, a survey was made of the traffic on the eleven radial roads outside the proposed city circle road. Traffic officers stationed at these points stopped and questioned drivers of all vehicles during peak hour periods. Three questions were asked: Where did you begin your present journey? Where are you going? Which route have you taken (or do you intend to take) through the city? Fourteen enumerators were required on the most heavily traveled road, and of 7,120 vehicles stopped, none was held up longer than 20 seconds. Notice boards were set up 300 ft. ahead of the census points warning that a traffic census was in operation ahead. The figures so obtained indicated that 20 to 50% of the total traffic could be diverted by the proposed circle road. This road is 3.32 miles long, of which 1.84 miles will follow the lines of existing roads.[D17]

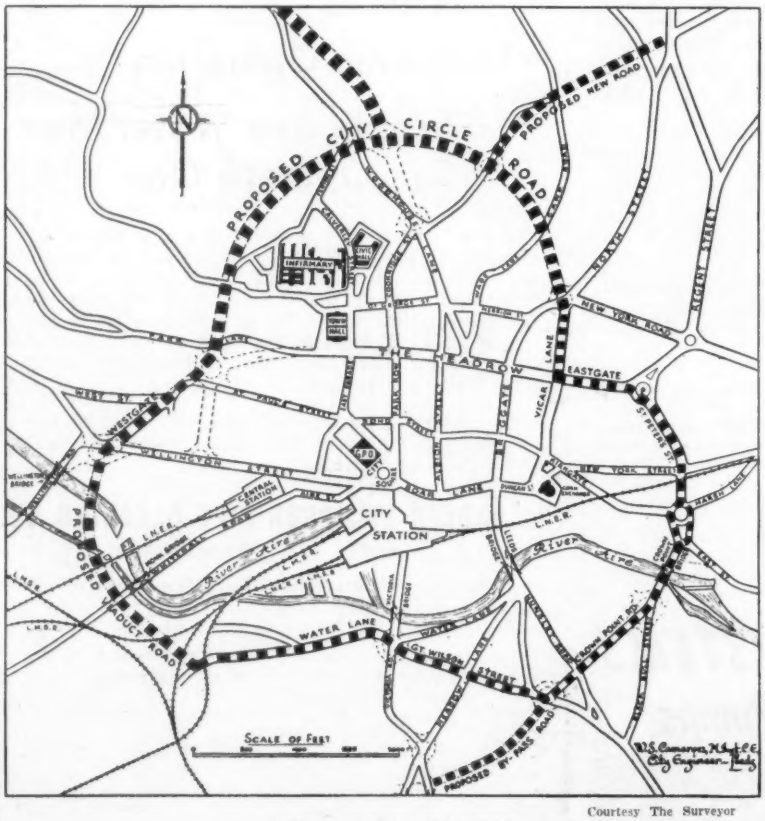
Signs on An 8-Lane Highway

Route 25 near Newark, N. J., which carries an average of 60,000 vehicles a day, 100,000 and more on holidays, is being widened from 4 lanes to 8. Drivers on inside lanes can not see roadside signs without taking their eyes from the road, so overhead signs are being placed on steel bridges with spans up to 80 ft. and with 20 ft. vertical clearance, so that a driver 100 ft. behind a truck can see it looking above the truck when he is 200 ft. away, or 750 ft. away when 400 ft. behind the truck. Servicing the signs will be done from a catwalk on top of the bridge. The signs use 15" letters of the white neon channel type on a black background; neon tubes because of their long life, and channel type to prevent the light from one letter interfering with that from adjacent ones. These are legible for 750 ft., day or night. Each sign shows only two names—the nearest town and the nearest important city.[N32]



Courtesy Roads & Streets

Sign spacing for 8-lane highway.



Courtesy The Surveyor

Plan of Leeds city circle road.

Electric Soil Stabilization

The Russians are developing a procedure for the application of direct electrical current in stabilizing clayey soils. Anodes and cathodes are placed in the ground 0.5 to 1.0 meter apart and current applied at 30 to 200 kwh at 100 to 22 volts per meter. Electro-osmosis of water, substitution of aluminum for other replaceable bases, and formation of aluminum and iron gels are believed to be responsible for the stabilization. Plasticity, shrinkage, expansion and frost heave were minimized, apparently due to an irreversible coagulation of the colloids. Migration of moisture in frozen ground is impeded.[E32]

Considering Maintenance In Designing Highways

Since 1932 Connecticut State Highway Dept. has developed a system whereby the future maintenance of a highway is given full consideration in designing and constructing it. Previous to that time no consideration had been given to winter maintenance in designing projects; no provision was made to prevent snow water from the outside of banked curves from running across the pavement, or for snow storage back of the shoulder in cuts; no attention was given to cross-section outside of the

shoulder lines; extremely flat drainage grades caused ponding; and no protection was given slopes.

In 1932 a new position in the maintenance bureau was created—the construction examiner for maintenance. He examines all plans prepared by the design section, before they are finally adopted, for any features that might cause additional maintenance costs or necessitate changes after completion of construction, studying all details of drainage structures and outlets, stability of subgrades and slopes, cross-slopes with respect to snow removal or snow water, relation of proposed improvements to existing improved property, and safety features, such as replacement of guard rail with flat slopes. On the basis of this examination he recommends changes in the plans. Again, after the plans have been completed but before contracts are let, he examines them and reports any desired changes to the engineer of location and design. The latter's decision is final unless appealed to the deputy commissioner.

As a result of this procedure, a minimum grade of 1% (if practicable) is specified for drains; curbs are eliminated and a depressed center parkway provided, with shoulders on each side of the concrete roadway. The maintenance bureau has recently requested that designs provide a 5-ft. shelf back of the shoulder-line in cuts for disposal of snow, and a minimum of 8 ft. between the shoulder-line and sidewalk for snow deposit. Thousands of feet of railing have been eliminated by constructing fills with flat slopes.[R15]

Resurfacing Pulaski Highway

Maryland's Pulaski highway from Baltimore 23 miles north to Aberdeen averages more than 21,000 vehicles daily. In 1938 it was paved with two 20 ft. concrete roadways separated by a convex 30 ft. park area. The pavement sloped uniformly inward to a lip curb 3" high and 9" wide. The lip curb did not function as designed and ice often formed in the lip gutters and moisture entered the subgrade, which was not provided with a protective subbase. This resulted in extensive cracking, and the highway was resurfaced last year with concrete.

Badly broken slabs were removed and the soil under them replaced with bank-run gravel thoroughly compacted. Slabs that could be salvaged were mud-jacked to grade, cracks sealed, and hot asphalt pumped in to provide a waterproofing seal over the subgrade. The cross-section was changed to give each roadway a center crown, widen it 2 ft. on each side, and make the center parkway concave instead of convex. The old lip curb was removed with jackhammers. Calcium chloride-treated gravel shoulders 9" thick were built along both sides of pavement, 7 ft. wide on the outside and 3 ft. on the inside. Underdrains were laid 18" outside the edges of each roadway, using perforated asphalt-coated corrugated metal pipe backfilled for 6" with 1"-¼" aggregate, with concrete sand over this. Air-entrained portland cement was used. Mesh reinforcement was placed 2½" below the surface. Emulsified asphalt was sprayed on for curing. Doweled expansion joints using ¾" cork were spaced 360 ft. apart, doweled contraction joints at 30 ft. intervals and dummy hinged joints at 15 ft. intervals. The resurfacing varied in thickness from a minimum of 5".[N47]

Turf on Stabilized Shoulders

New York State Dept. of Public Works has made a study of the construction of mechanically stabilized road shoulders which will support the growth of a good vegetative cover under occasional traffic. Test shoulders were used on two roads where soil conditions were distinctly different. In one location the soil was a sandy loam, much of it very low in fines. In the other there was about 6" of top soil which had been imported to cover shoulders and backslopes and which contained up to 60% of soil and clay and was unstable under traffic when wet; this being underlain with sandy material. In the former location, a small quantity of binder soil was added and incorporated to a depth of 6". In the latter location, about 6" of

the underlying sand was plowed up into the top soil. The aim was to obtain a mixture that would meet the AASHO specifications for stabilized courses. The shoulders were divided into test areas to study the effects of different types of soil materials, kinds and amounts of animal and chemical fertilizers, lime, mulch, seed and methods of seeding.

During the one or two years since construction, all the shoulders built on the sandy material have been stable under traffic and during the worst seasons; those built of top soil have been stable under traffic but rutted when saturated during thaws. The turf has been satisfactory except where subjected to daily use, as at mail boxes. The following conclusions were reached.

1. Mechanically stabilized soil shoulders, which are stable under traffic, will support a satisfactory turf growth when subjected to occasional use by traffic.
2. Adequate drainage is essential.
3. The type of mulch material used appeared to have no appreciable effect on the growth of turf on the shoulders of the tests.
4. Many of the cultural practices of establishing turf, such as raking and rolling, may be eliminated with resultant economies and no decrease in the quality of turf required for highway shoulders.
5. Top soil appears to have been unnecessary to secure a satisfactory turf on these tests.
6. Rate of seeding, season of seeding and kind and amount of fertilizer are of relatively lesser importance within reasonable limits.
7. The varieties of plants rated best after two seasons growth under the conditions of the test are: Red Fescue, Smooth Brome, Orchard Grass, Redtop, Perennial Rye, Wild White Clover, Birdsfoot trefoil, Yarrow.[N49]

Lime-Treating Subgrade Soils

Where subgrade soil is clay, sand in the only commonly used admixing agent which has proven successful in providing a flexible base. In parts of Texas where sand is not available, lime has been used with results that very definitely prove that there is a place for it among road building materials. It greatly facilitates the pulverization of highly plastic clay to permit thorough incorporation of cement or asphalt; makes it water repellent and thus more stable through maintenance of proper moisture content. Several tests showed the plasticity of soil to be decreased from 52 to 20 by 4% of lime and to 12 by 8%; and the linear shrinkage from 25 to 13 and 8 respectively. In addition to making highly plastic subgrade soils more stable and water-repellent and assist the pulverization of them, lime is found to improve the quality of substandard flexible base materials for supporting an asphalt surface, and to stabilize highly plastic clays to the extent necessary to make them satisfactorily support an asphalt surface. Waste lime is generally used, which is obtained from kilns at a very low cost.[P18]

Undersealing With Asphalt

The Texas Highway Dept. has undersealed several hundred miles of concrete pavement with asphalt, which is considered a necessary treatment prior to leveling and surfacing. It stabilizes rocking slabs, fills cavities, regains uniform subgrade support, seals out surface water, and assures a lower and more uniform moisture content of the subgrade. The melting point of the asphalt used is more important than the penetration. The amount required is 1½ gal. per sq. yd. to give a minimum membrane thickness of ¼", plus 1 gal., more or less, to fill cavities. Beginning in 1945 the state has let the work by contract at prices which have decreased as contractors developed more economical methods. Recently the prices for drilling 1½" holes have averaged 5 cts., and for asphalt in place 11 cts. a gallon. On 459 miles of 18-ft. pavement the number of holes per mile has averaged 1504 and the asphalt 25,800 gal. A third to a half of the holes are not pumped but are used as inspection holes. Contractors use a tractor carrying three air drills, all of which can be operated at once from the driver's seat, and an average of 220 holes per hour

is common. The pumping equipment usually consists of 2 asphalt distributors with pumps, 2 car heaters, a tractor and a utility truck. With a crew of 15 men it places an average of 20,000 gal. of asphalt per day.[P19]

Asphaltic Concrete Curbs

The Maryland State Roads Commission is constructing a wide gutter and a curb 8" high in cuts along U. S. Route 1 to reduce maintenance costs. The road here contains two lanes of flexible pavement in each direction. The gutter, about 3½ ft. wide, provides an over-all shoulder width of 8 ft. Asphaltic concrete was selected for the gutter and curb instead of portland cement because it was believed to be most economical, required less preliminary work, permits small areas to be paved more easily, and will suffer less damage should settlement of the underlying soil occur.

A steel form is used of the type used for portland cement concrete. The asphaltic concrete is purchased from a commercial plant and delivered on the job at a temperature of about 300°. It is placed against the back form and roughly shaped by shovel, then finished with a wooden trowel. One ton of material makes nearly 10 lin. ft. of curb. The concrete costs about $7.22 per ton delivered. The curb costs 73.5 cts. per lin. ft., of which 46 cts. is for the asphaltic concrete, 13.7 cts. for placing and finishing it, the rest for excavation and distributing, setting and removing forms.[E31]

Sand-Shell Hot-Mix Surface

Texas Highway Dept. completed, in February 1947, 11.6 miles of 28-ft. roadway in which the base was a sand-shell aggregate and the surface course was a hot-mix bituminous sand-shell—possibly its first use on a highway. This was placed on an old asphalt surface on a shell base. The old surface was loosened and spread to give 28 ft. about 2" thick. On this was placed enough new sand-shell material to bring the rolled thickness up to 8", and old and new material were then thoroughly mixed, sprinkled and compacted in 1" to 2" layers with a pneumatic roller, finishing with a steel roller. When this base was thoroughly dry it was cleaned and primed with 0.2 gal. of MC 1, and plant-mix sand-shell-asphalt applied in two courses to a total thickness of 5", the topping mix of aggregate passing ¼" and the asphalt being 85-100 penetration.[N50]

Volumetric Proportioning And Continuous Mixing Plants

Ohio Dept. of Highways in 1946 tested the practicability of volumetric proportioning and continuous mixing asphalt plants. The plant used had 4 hot storage aggregate bins, all discharging onto an endless feeder, the rate of discharge from each being controlled by a calibrated gate. The asphalt cement was introduced into the mixer with the aggregate by a positive displacement pump, interlocked with the drive controlling the flow of aggregates. Satisfactory and uniform results were obtained, and new specifications will permit the use of such plants if there be added a revolution counter reading to 0.001 of a revolution on the proportioning unit, an automatic control to stop all operation if the level of aggregate in any bin falls below the top of the outlet gate, and a means of preventing segregation when the mix is discharged into trucks.[N53]

Plasticity Index in Sand-Clay Base Courses

To study the effect of variations in plasticity index on the behavior of base courses composed of sand-clay mixtures, a test road 14.5 mi. long was constructed in North Carolina in 1936-37 with such a base as support to a bituminous surface. There were four sections, in which the plasticity indexes were 0-4, 4-8, 6-10 and 12-16 respectively. The base was made 7" thick, increased to 10" at four locations where the subsoil was poor. Inspection of the road after 8 yrs. of service led to the conclusions that increasing the thickness from 7" to 10" where subsurface water made the subgrade unstable was

not effective; that failures in the bituminous surface were due to high plasticity index; that where the index was 12-16 the base was definitely unsatisfactory, where it was 6-10 it was not entirely satisfactory, where it was 0-4 and 4-8 it was satisfactory. However, plasticity indexes greater than 6 have given good results in other instances under favorable drainage and climatic conditions.[U6]

Bibliography of Highway and Airport Literature

D *The Surveyor*
May 30

17. Origin and Destination Traffic Census. By W. S. Cameron. Pp. 279-280.

E *Engineering News-Record*
May 15

11. Curbs Built of Asphaltic Concrete to Cut Highway Maintenance Costs. Pp. 88-89.
12. Electrical Stabilization of Soil. Pp. 100-101.

J *American City*
June

5. The Design of Concrete Pavements for City Streets. By E. J. Hennings. Pp. 76-78.
6. Airport Facts vs. Fancy. By J. B. Bayard, Jr. Pp. 80-82.
7. The Case for Urban Expressways. By Thomas H. Macdonald. Pp. 92-93.

K *Proceedings, American Society of Civil Engineers*
May

1. New Formulas for Stresses in Concrete Pavements of Airfields. By H. M. Westergaard. Pp. 687-701.

N *Roads and Streets*
May

47. Resurfacing U. S. 40 Maryland. By H. K. Glidden. Pp. 49-52, 56.
48. The Importance of Maintenance in Our Highway Program. By C. L. Motl. Pp. 58-60, 62-64, 71.
49. Turf on Mechanically Stabilized Shoulders. By Harry H. Iurka. Pp. 68, 70-71.
50. A Sand-Shell Hot-Mix Job Near Galveston, Tex. Pp. 82-83.
51. Compaction of Soils. By A. O. Williamson. Pp. 84, 86.
52. Improved Signs for New Jersey. By Ralph L. Fisher. Pp. 90-92.
53. Volumetric Proportioning and Continuous Mixing Asphalt Plants in Ohio. By Fred W. Kimble. Pp. 101-102.

O *Roads and Bridges*
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30. Behavior of Bituminous Surface Treatments. By W. H. Goetz. Pp. 77-81, 118.
31. Application of Aerial Strip Photography to Highway and Airport Engineering. By J. E. Hittle. Pp. 86-90, 136.

P *Public Works*
June

18. Lime Treatment Permits Use of Substandard Flexible Base Materials. By B. B. Freeborough. Pp. 17-18, 20.
19. Undersealing Pavements with Asphalt. By Hugh A. Wallace. Pp. 23-24.
20. Equipment Used in Highway Construction. P. 24.
21. Legal Decisions Regarding Streets and Highways. By John Simpson. P. 36.

R *Better Roads*
May

15. Construction Design Benefits From Maintenance Experience. By C. A. Campbell. Pp. 23-24, 36.
16. What's That About the Weather? By R. Getty Browning. Pp. 27-29.
17. Getting Ready for Black-Topping. By Frank K. Evans. Pp. 41-44.

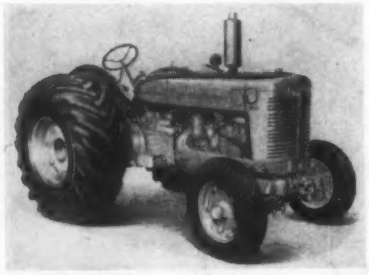
U *Public Roads*
April-May-June

6. Experimental Sand-Clay Base Course in North Carolina. By James A. Kelley. Pp. 299-306.
7. Speed Transition Ramps on a Bridged Rotary. By Robert O. Swain. Pp. 307-311.

PUBLIC WORKS Equipment News

Single Rear Tires for International I-9 and ID-9 Tractor

The International Harvester Co., Chicago, Ill., now equips its ID-9 (52-hp. diesel) and I-9 (55-hp. gasoline) tractors with single rear tires and wheels in place of the dual wheels, which left



The IHC wheel tractor with single rear tires.

a center ridge in soft ground and interfered with following equipment. Tires are 18.00x26, and permit a drawbar pull of 5500 to 7500 pounds, which is sufficient for large plows and discs, scarifiers, rollers, 10-ft. blade graders, etc.

Pioneer Highly Portable Gravel Plant

High aggregate production is claimed by Pioneer Engineering Works, Minneapolis, Minnesota, for its new 34-S "Continuflo" portable gravel plant. The total weight, less power unit is approximately 40,900 pounds. The plant is equipped with six sets of dual 9:00 x 20 pneumatic tires, and meets state highway load and dimension limits. A 7' hopper, equipped with mechanical feeder, takes the feed at the rear end of the plant. Processed material is delivered from the front end. Units consist of a 1024 jaw crusher, a 24"x16" roll crusher, and a 3'x8'-2½ deck vibrating screen, equipped with sand screen. Only two men are required to operate the plant, one on the drag-line or shovel, the other on the plant itself.

This Odometer Speeds Up Measurement of Distances

There is nothing new about the use of a wheel and counting device to enable a one-man survey party to make rough measurements rapidly, but this new development of a long-used tool has many improvements. It is rugged, is easy to operate, and convenient to read. The wheel is mounted on ball bearings, and all other rotating parts turn on self-oiling, special-type bearings. A trigger disengages the counter and connects it to the reset knob. Aluminum, brass and plated steel parts insure freedom from corrosion. The counter records to 9999 ft. Weight is only 8½ pounds. For full information write Matthews Instrument Co., 1129 Boylston St., Newton Upper Falls, 64, Mass.

For Sub-Surface Investigations and Finding Ground Water

The Gish-Rooney earth resistivity apparatus, by means of measurements made at the ground surface, gives information about subsurface conditions. It locates water-bearing formations and estimates their depths. It locates and measures the distance to bedrock, locates faults, other geological features,

The Matthews Odometer for measuring distances.

and gravel deposits, and gives information concerning stratification and overburden. For explanations and information, write to Geophysical Instrument Co., 1920 N. Nash St., Arlington, Va.

Caterpillar Hydraulic Controlled Bulldozer

Four sizes of bulldozers, with hydraulic controls, are announced by Caterpillar Tractor Co., Peoria, Ill. These are designed exclusively for the diesel D8, D7, D6 and D4 tractors. Both straight and angling blades are available for the first three; the straight blade only for the D4. These bulldozers are in addition to the cable controlled bulldozers now made.

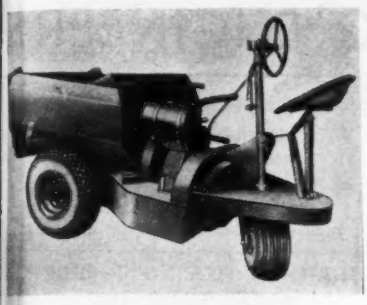
Test for Effective Dosage for Algae Control

By means of a simple procedure, it is now possible to determine the exact amount of copper sulphate required to inhibit or destroy algae growth. This test, known as the "DM" test, can be performed effectively with a kit just developed by LaMotte Chemical Products Co., Towson, Baltimore 4, Md., eliminating the haphazard use of chemical, and insuring proper control.

A Power Stirrer for Laboratory Work

This is a 3½-pound unit, 115 volts AC or DC, which develops unusually high torque. Speeds are up to 1200 rpm.; inch-ounces of torque are up to about 2€0. Nice looking little job. Write Eberbach & Son Co., Ann Arbor, Mich.

Pioneer portable gravel plant.



Some wheelbarrow!

A Mechanized Wheelbarrow

This is an over-sized wheelbarrow, for it is capable of carrying one-ton loads at speeds up to 15 mph. It is equipped with specially large tires so that it can run almost anywhere, even over loose sand. Since it weighs only 1000 pounds, the makers say it can be used for scaffold or second- or third-story work. It is especially useful for pouring concrete floors and slabs. It has a 6 hp. engine, with 4 speeds and reverse. More details from Novo Engine Co., Lansing, Mich.

Garbage Grinders

An excellent 8-page booklet on garbage grinders for municipal plants where garbage is to be disposed of through the sewer system has been issued by Jeffrey Mfg. Co., Columbus 16, Ohio. The booklet contains brief, but informative, material on this problem, recommends methods of feeding, gives capacities, and shows typical grinding stations.

Ingersoll-Rand Paving Breaker

The PB-8 paving breaker, recently announced by Ingersoll-Rand Co., Phillipsburg, N. J., is an 82-pound unit designed for heavy-duty demolition and general paving breaking. It may also be converted to a pile driver or a spike driver by changing front-heads. More information on this new unit is contained in Bull. 4051.

Ingersoll-Rand Paving Breaker.

Northrop & Co. Moves Sales Office

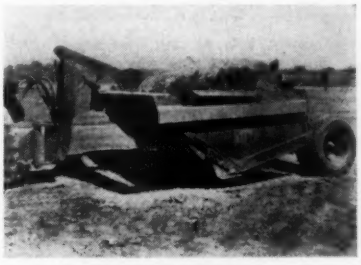
Northrop & Co., Inc., makers of Bond-O jointing compound, have moved their office from 50 Church St., New York, to their plant at Spring Valley, N. Y.

Sheppard Diesels on West Coast

R. H. Sheppard Co., Inc., Hanover, Pa., has opened a factory branch office at the foot of Hyde St., San Francisco, which will be in charge of Emil Riutta. Complete lines of Sheppard products and of spare parts will be maintained.

Two-Wheel High-Speed, Dirt-Moving Scraper

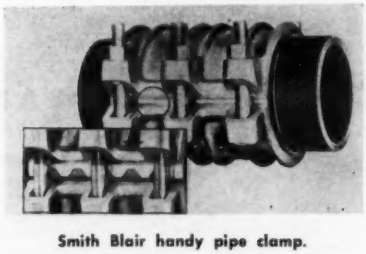
For use with large wheel tractors, American Tractor Equipment Co., Oakland, Calif., has developed a 2-wheel scraper, designed for high-speed use. This is made in three sizes—4.5, 5.6 and 6.9 cu. yds. heaped. These units are designed for the International I-9, Oliver 900 and similar heavy-duty wheel tractors, and are intended for leveling, stripping, roadbuilding, airport grading and similar duties.



Ateco 2-wheel dirt-mover.

Bronze Pipe Repair Clamp

The manufacturers say that this is so simple that one man can install it in six minutes. It forms a complete watertight circle that compensates expansion and contraction of the pipe. Installation requires only bolting of the two halves of the coupling over the pipe. According to the manufacturer, Smith-Blair Co., South San Francisco, Calif., the 4-inch size coupling will withstand 1000 pounds hydrostatic pressure.



Smith Blair handy pipe clamp.

Light-Weight Bulldozer and Snow Plow

The Cunningham tractor, the basic unit for the Cunningham mower, can be used also as a bulldozer for light work, employing the 30-inch snow plow attachment. It is particularly useful in spreading cinders and dirt or gravel, and for building shallow drainage ditches or contour grades. Full information from James Cunningham, Son & Co., 13 Canal St., Rochester, N. Y.

Philadelphia to Install Ozonization Unit

The city of Philadelphia, Pa., has contracted with the Ozone Processes Division of the Welsbach Corp., for the installation of the largest ozonization unit in the United States. This will be used for treating 36 mgd. of water daily for taste and odor removal. The installation of this plant is a step in providing better water for Philadelphia from present sources while plans are being made for future supplies from distant sources.

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TECHNICAL BOOKLETS

Equipment for Sewage Disposal Plants and Water Works is described in Bulletin 23-120-B10, 8 pages, issued by Roots-Connersville Blower Corp., Connersville, Ind. Among the equipment covered are rotary positive and centrifugal blowers, driving arrangements, vacuum pumps, gas and water meters, etc. Descriptions and engineering data are given.

Weed Control data are given in a folder issued by Sherwin-Williams Co., Cleveland, O., and other firms. This covers the butyl ester formulation of 2,4-D, and is called Weed-No-More 40. It controls ragweed, poison ivy, chickweed and many other weeds.

Quick Couplings, caps and allied products are described, with engineering data and specifications, in a new 20-page catalog by Roylyn, 718 West Wilson Ave., Glendale 3, Calif.

Construction, utilizing small size diesel track-type tractors and diesel engines and electric sets, is outlined in Form 10183, 16 pages, issued by Caterpillar Tractor Co., Peoria, Ill. This booklet shows how this equipment is used on smaller jobs; includes bulldozers, scrapers, loaders, scarifiers, discs and harrows, tampers and chisels.

Automatic Remote Controls are described in a bulletin by General Electric Co., Schenectady, N. Y. Information is given on application, operation and use.

Electrical Diagrams, their purpose and use, is explained in a bulletin by General Electric Co., Schenectady, N. Y. Contains practical guidance on the use and functions of four types of diagrams: one-line, elementary, connection, and interconnection.

Corrosion-Resistant top-lubricated plug valves made of Duriron or Durichlor are described in a new bulletin by the Duriron Co., Dayton 1, O. Contains engineering and dimension data

Clam Shell Buckets are described in Bulletin 697, issued by the Hayward

The Hough "Payloader" shovel is a ¾-yd. fast working machine designed for grading, stripping and general material handling.

Company, 50 Church St., New York 7, N. Y. This shows how the E-16 bucket can be adapted for excavating, mud work, dredging, etc.; a chart lists bucket load capacities, weights and dimensions in terms of various materials.

Portable air compressors are described in a bulletin covering the new Davey Air Chief, 60 to 315 cfm. Davey Compressor Co., Kent, Ohio.

Pittcide is a new granular disinfectant and germicide composed essentially of stabilized calcium hypochlorite. It shows no appreciable loss of strength over long periods of storage. Columbia Chemical Division, Pittsburgh 13, Pa.

Road Repair and Construction equipment is described in a folder issued by Littleford Bros., Inc., Cincinnati, O. This covers mainly emulsion sprayers and the 84-D maintenance kettle.

Liquon Water Softeners

New designs have been announced by the Liquid Conditioning Corp., 114 East Price St., Linden, N. J., for both zeolite and hot lime soda softeners. Five types of the lime-soda softeners are available to cover a wide range of plant conditions and requirements. These are designed mainly for treating boiler feed water. The zeolite softeners employ a new type of synthetic resin zeolite, which is said to have exceptional capacity, thus reducing the size of the unit required; also, the zeolite is non-siliceous and thus does not impart silica to the treated water.

County Aid Road Construction in Alabama

Reasonable costs were reported during the year 1946 on work being done by county forces and equipment in Alabama. Thirty counties organized outfits and engaged in direct labor projects. Preliminary accounting has shown a low unit cost of most construction items as compared with current competitive bids. This is attributed to several factors. The county has the advantage over a contractor in the fact that no moving in or out charges are involved, and that it is a non-profit undertaking. Another consideration of importance is that there is no waiting period between jobs. While a county outfit is engaged on one project, the preliminaries for the next job are under way, so that when certain phases of the first job are completed, that equipment may be moved on to the second, without loss of time for either personnel or equipment.

It is believed that the comparatively small size of projects in all counties makes it desirable to develop small well balanced construction outfits in each county, with a competent superintendent who is free to organize and direct the work under general supervision of the County Engineer. It has accordingly been the policy of the County Aid Bureau of the Alabama Highway Department to encourage the counties to put this plan into operation as rapidly as possible. From its application it is hoped to reduce the cost of first stage construction, including base course, while generally leaving the paving to be done by contract.

A New Filter Cloth

Sol Seid, Superintendent of the sewage treatment plant at New Brunswick, N. J., has been experimenting recently with a new type of cloth at the vacuum filters used for sludge dewatering. The new cloth is made of a synthetic fiber which is resistant to chemical action and mechanical abrasion. It is a lint-free material that passes liquids freely and does not plug easily, and is said to be unaffected by changes in temperature.

The new fabric is still in operation on a lime treated sludge after 500 hours of service, whereas the cloth formerly used had an average life of only 70 hours. The cost of the new fabric, based on service life, is proving to be less than 10 per cent of the cost of the material used before. *Sewage Works Journal.*

Spotting log to place truck for shovel loading.

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382. For a copy of this compact folder on a hydraulic pipeline scraper which cleans all kinds of mains from 4 inches to 14 inches write to Dept. PW, Carver-Stimpson Pipe Cleaning Co., Walters, Okla.

Full Data on Method and Results Of Water Main Cleaning

383. Water main cleaning by the National Method is title of 4-page folder describing methods and results obtained, with full data. National Water Main Cleaning Co., 30 Church St., New York 7, N. Y.

Oil or Water Lubricated Turbine Pumps

456. Oil lubricated turbine pumps with open impellers. Five types of heads available. Specifications and illustrations in new bulletin 6930M-2 issued by Fairbanks, Morse & Co., Dept. P.W., 600 So. Michigan Ave., Chicago 5, Ill.

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540. New Odometer measures as you walk. Ingenious labor and money saver for surveyors described in illustrated circular. Address: Matthews Instrument Co., 1129 Boylston St., Newton Upper Falls 64, Mass.

Two-Way FM Radio Telephone Equipment for All Departments

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Low Cost Air From Long Lasting Compressor

2. Jaeger air compressors, made in sizes 60 to 500 cu. ft.; trailer, truck, tractor and stationary mounted, gas, Diesel and electric power. Catalog and data. The Jaeger Machine Co., 400 Dublin Av., Columbus 16, O.

Data on All Types of Bins and Batching Plants

11. Good illustrations and useful data on all types of Heltzel Highway Bins, for truck mixer charging, bulk cement plants, enclosed bucket elevators, belt conveyors, etc. Heltzel Steel Form & Iron Co., Dept. P.W., Warren, O.

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70. Useful new 60 page catalog on standard corrugated pipe, multi-plate pipe and arches and 18 other drainage and related products for culverts, sewers, subdrains, flood control, airports, water supply and other types of construction. Ask for "Armco Products for Engineering Construction," Armco Drainage and Metal Products, Inc., Dept. PW Middletown, Ohio.

Handle All Kinds of Tough Grading Jobs Economically

98. The Austin-Western 99M Power Grader with its powerful all wheel drive handles difficult jobs with economy and efficiency; and does better work on grading, ditching, scarifying, snow ploughing, loading, mixing, bulldozing, shoulder trenching and backsloping. Write for Bulletin 1946. Dept. P.W., Austin-Western Co., Aurora, Ill.

Save Money, Busting, Cutting, Digging, etc.

110. Powerful self-contained gasoline hammers illustrated in new booklet. Used as paving breakers and spike drivers. Easily portable, economical. Write Syntron Co., 660 Lexington, Homer City, Pa.

Methods of Installing Steel Sheet Piling

112. Illustrated descriptions of both standard and interlock corrugated steel sheet piling of minimum weight, maximum strength, ease of handling with methods of installation are contained in a booklet. If you have a job involving piling write Caine Steel Co., Dept. P.W., 1820

Reliable Every Purpose Pumps

117. New brochure by Gorman-Rupp Co., Mansfield, Ohio, illustrates and describes many of the pumps in their complete line. Covers heavy duty and standard duty self-priming centrifugals, jetting oumps, well point pumps, triplex road pumps and the lightweight pumps.

For Reliable Low-Cost Light and Power Anywhere

392. 20-page catalog P.W. describes "Dieselectric" plants 3 to 10 KVA, and diesel engines from 4 to 12 H.P. These are easily transported and will produce reliable, low cost light and power anywhere. Write WITTE ENGINE WORKS, Division of Oil Well Supply Company, Kansas City 3, Mo.

Tandem Roller with Air Clutches Starts and Shifts Easier

515. Finger tip steering, air clutches, full visibility all around, low center of gravity, handy location of key parts, all gear drive are features of new Apsco tandem roller. Write for bulletin: Dept. PW, All Purpose Spreader Co., Fuller Road, Elyria, Ohio.

Single Unit Impact Breaker and Pulverizer Has No Gadgets

521. Breaks stone into cubical shapes, can be used as pulverizer, too. Simple design. Gives years of service. Light weight and strong. Get new bulletin PW today. The Eagle Crusher Co., Inc., Galion, Ohio.

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SNOW FIGHTING

For High-Speed Snow Removal

350. "Frink One-Way Sno-Plows" is a four page catalog illustrating and describing 5 models of One-Way Blade Type Sno-Plows for motor trucks from 1½ up to 8 tons capacity. Interchangeable with V Sno-Plow. Frink Sno-Plows, Inc., Clayton, 1000 Islands, N. Y.

Fast, Efficient Skid-Proofing

385. Get full facts about Baughman Light-Weight Cinder Spreaders, fast operators for cinders, sand, salt, chips, etc. Free flowing at low temperatures. 9-17 cu. yd. cap. Write Dept. P.W., Baughman Mfg. Co., Inc., Jerseyville, Ill.

STREETS AND HIGHWAYS

How to Use Less Labor in Resurfacing

15. You can mechanize your resurfacing with these Portable Bituminous Mixers. 6 to 14 ft. sizes for resurfacing and maintenance. Helpful booklet issued by The Jaeger Machine Co., 400 Dublin Avenue, Columbus 16, Ohio.

Levels Sidewalks and Curbs Quickly and Easily

107. How the Mud-Jack Method for raising concrete curb, gutter, walls and streets solves problems of that kind quickly and economically without the usual cost of time-consuming reconstruction activities—a new bulletin by Koehring Company, 3026 West Concordia Ave., Milwaukee 10, Wis.

How to Build and Maintain Roads With Tarvia

111. New "Tarvia Manual" is packed with useful data on how to build and maintain roads with Tarvia. Each step is illustrated with excellent action pictures, 64 pp. 103 illus. Write to The Barrett Div., 40 Rector St., New York 6, N. Y.

Speed Your Work With These Powerful Motor Graders

128. Two powerful Galion motor graders designed to answer every requirement for more speed in road, airport, dam and housing construction work are fully described in a folder illustrated with many action pictures. Issued by Galion Iron Works & Mfg. Co., Galion, Ohio.

Strong, Speedy, Low-Cost Maintainer Has Many Uses

130. BG Maintainer, a powerful speedy, low-priced machine for light road maintenance. Full details in illustrated folder. Huber Mfg. Co., Dept. P.W., Marion, Ohio.

Tandem, 3 Wheel and 3 Axle Road Rollers

138. "The Buffalo-Springfield" line of road rollers (tandem, 3-wheel, and 3-axle) are described in the latest catalog P.W. issued by the Buffalo-Springfield Roller Co., Springfield, Ohio.

Here's a Roller for Every Need

141. Three-Wheel and Tandem Rollers, 5 to 8-ton and 10 & 12 ton sizes; also variable weight tandem roller for new highway surfacing and old road conditioning. Ask for new bulletin. Dept. P.W., Huber Mfg. Co., Marion, Ohio.

Want High-Service Low-Cost Roads?

150. "High-Service, Low Cost Roads" sets forth the principles and advantages of road surface stabilization with calcium chloride. Complete, interesting and well illustrated. 34 pages. Sent by Solvay Sales Corp., Dept. P.W., 40 Rector St., New York 6, N. Y.

Mix-in Place Roadbuilders Save on Scarce Labor

187. Mix-in Place Roadbuilders. Bituminous Pavers, Concrete Bituminous Finishers. Adjustable Spreaders, Forms, etc. —4 complete catalogs in one cover, issued by the Jaeger Machine Company, 400 Dublin Ave., Columbus 16, Ohio.

Here's Your Diesel Tractor!

190. Big 48 page catalog describes and lists many uses for International Diesel Tractors. Write International Harvester Co., Dept. P.W., 180 North Michigan Ave., Chicago 1, Ill.

Latest Maintenance Equipment For Blacktop Roads

290. "Blacktop Road Maintenance and Construction Equipment" — Asphalt and tar kettles, flue type kettles, spray attachments, tool heaters, surface heaters, road brooms and rollers. This is modern and up-to-date equipment for blacktop airport and road construction and maintenance. Write for Catalog R. Littleford Bros., Inc., 452 East Pearl St., Cincinnati 2, Ohio.

Mow Clean and Fast In Tight Corners

510. Send for latest literature about the Cunningham Mower for Fence Rows, Parking Areas, Driveways, Picnic Grounds and many other jobs. 3 ft. cut, variable speed, rugged, easy to handle. James Cunningham, Son & Co., Dept. 16, 13 Canal St., Rochester 8, N. Y.

All Purpose Spreader Spreads 2 to 10 ft. Wide

514. Saves labor, spreads 0 to 100 lbs. a sq. yd., dust up to 1" material, forward, reverse, on curves, hills or straightaway. Assures uniform, even density of spread. Write for bulletin: Dept. PW, All Purpose Spreader Co., Fuller Rd., Elyria, Ohio.

SEWAGE DISPOSAL

Non-Corrosive, Long Lasting Low Cost of Sewer Pipe

72. Get this new engineering data on clay pipe for sewers. Withstands acid, alkali and gas attacks indefinitely. Cuts maintenance costs to a minimum. Write Dept. P.W. National Clay Pipe Mfrs., 111 W. Washington St., Chicago 2, Ill.

Does Air Sabotage Your Pipe Lines and Pumps?

357. Automatic Air Release Valves for water, sewage and industrial uses automatically vent air accumulations. Ask for latest illustrated engineering bulletins. Simpex Valve & Meter Co., 6750 Upland St., Philadelphia 42, Pa.

Valuable Booklet on Porous Diffuser Plates and Tubes

367 A valuable booklet on porous diffuser plates and tubes for sewage treatment plants. Covers permeability, porosity, pore size and pressure loss data, with curves. Also information on installations, with sketches and pictures, specifications, methods of cleaning and studies in permeability, 20 pp. illustrated. Write to Norton Company, Dept. P.W., Worcester 6, Mass.

How You Can Clean Sewers From Streets Easily and Inexpensively

386. 32-page illustrated booklet explains how a city can clean its sewers and culverts with its own forces using the up-to-date Flexible Sewer Rod equipment. Illustrates and describes all necessary equipment. Issued by Flexible Sewer Rod Equipment Co., 9059 Venice Boulevard, Los Angeles 34, Calif.

How Cities Can Do Complete Sewer Cleaning From Street

387. Literature illustrating how cities, towns and villages using OK Champion Sewer Cleaners are doing a complete sewer cleaning job from street level. Three sizes of machines available in addition to full line of sewer rods and accessories. Issued by Champion Corporation, 4752 Sheffield Avenue, Hammond, Indiana.

All About Flow Meters

409. The primary devices for flow measurement—the orifice, the pitot tube, the venturi meter and others—and the application to them of the Simplex meter are described in a useful 24-page booklet (No. 300). Simplex Valve and Meter Co., 6750 Upland St., Philadelphia 42, Pa.

Make Low-Cost Electricity From Cheap Fuel

422. New booklet describes Sheppard Diesel Generating Sets that make low cost electricity from cheap fuel and give dependable service in the hands of any average operator. Write R. H. Sheppard Co., 250 Middle St., Hanover, Pa.

How to Select Main Line Meters

432. New bulletin illustrates Builders Air Relay system for liquids containing suspended solids like sewage. Eliminates corrosion, clogged pipes, etc. "The Selection of Main Line Meters," a highly informative and useful presentation, describes forms of differential producers and quickly solves typical problems with the use of graphic charts. Write Builders-Providence, Inc., Dept. P.W., 9 Codding St., Providence 1, R. I.

How to Make Better Sewer Pipe Joints

447. How to make a better sewer pipe joint of cement—tight, minimizing root intrusion, better alignment of joint. Permits making joints in water-bearing trenches. General instructions issued by L. A. Weston, Dept. P.W., Adams, Mass.

Save Trucks and Labor In City Rubbish Collection

459. For saving trucks, labor, and time in city rubbish collection get details of the new Dumpster-Kolector described in literature just published by Dempster Brothers, Inc., 996 Higgins, Knoxville 17, Tenn.

SEE COUPON ON PAGE 93

An Incinerator Necessity

463. Recuperator tubes made from Silicon Carbide and "Fireclay" Corebusters for maximum efficiency are described and illustrated in bulletin No. 11 issued by Fitch Recuperator Co., Dept. P.W., Plainfield National Bank Bldg., Plainfield, N. J.

How You Can Dispose Of Sewage Solids

464. Nichols Herreshoff incinerator for complete disposal of sewage solids and industrial wastes—a new booklet illustrates and explains how this Nichols incinerator works. Pictures recent installations. Write Dept. PW, Nichols Engineering and Research Corp., 60 Wall Tower, New York 5, N. Y.

Ask for This Design Data On Sprinkling Filters

469. Design data on sprinkling filters of Separate Nozzle Field and Common Nozzle Field design as well as complete data on single and twin dosing tanks, and the various siphons used in them, for apportioning sewage to nozzles. Many time-saving charts and tables. Write Pacific Flush Tank Co., Dept. P.W., 4241 Ravenswood Ave., Chicago 13, Ill.

Design Details for Sludge Collectors

480. Booklet No. P.W. 1642 on Link-Belt Circuline Collectors contains sanitary engineering data and design details. Catalog No. 1742 on Straightline Collectors, contains layout drawings, installation pictures and capacity tables. Address Link-Belt Co., 2045 West Hunting Park Ave., Philadelphia 40, Pa.

Useful Design Data on Sedimentation Tanks

482. "Sedimentation with Dorr Clarifiers" is a complete 36-page illustrated catalog with useful design data. Ask The Dorr Company, Dept. P.W., 570 Lexington Ave., New York 22, N. Y.

Packaged Sewage Treatment— Just Right for Small Places

488. "Packaged" Sewage Treatment Plants specifically developed for small communities — 100 to 3,000 population. Write for full description and actual operating data for this type of plant. Chicago Pump Co., 2348 Wolfram St., Chicago 18, Ill.

Look Into This Sewage Treatment Equipment

490. New bulletin P.W. fully describes and illustrates Hardinge sludge collectors for clarifiers, sludge concentration and skimming in both circular and rectangular tanks. Write Dept. P.W., Hardinge Company, Inc., York, Pa.

Need Equipment for Small Sewage Plant?

491. Small type Conveyor Sludge Collector and Skimmer, Grit Collector, Aero-Filter and other equipment for small sewage treatment plants are described and illustrated in bulletins from Chain-Belt Co., 1722 West Bruce St., Milwaukee 4, Wis.

Glazed Clay Blocks for Trickling Filter Underdrains

492. Illustrated bulletin describes the Natco Unifilter block of glazed, hard burned clay for underdraining filter beds. Write National Fireproofing Corp., Pittsburg 12, Pa., for free copy.

Engineering Details of Armcre Filter Blocks

525. Engineering bulletin shows construction details of Armcre Filter Bottom Blocks for better trickling filter results. Tells how Armcre blocks meet all requirements. Write to Ayer-McCarel-Reagan Clay Co., Brazil, Ind.

For Completely Successful Trickling Filter Systems

526. Armcre Filter Bottom Blocks by BOSCO. 12-page illustrated booklet explains how Armcre blocks meet every requirement for successful trickling filter operation. Gives full specifications and construction details. Includes use for Bio-Filtration. Write Bowerston Shale Co., Bowerston, Ohio.

One-Unit and Two-Unit Vitrified Floor Systems

527. Metro one-unit and two-unit vitrified clay blocks for trickling filter floors are described in illustrated catalog. Includes construction drawings, pictures and complete specifications. Ask for your copy today. The Metropolitan Paving Brick Co., Canton, Ohio.

All About Translot Filter Bottom Blocks

528. Illustrated Engineering Bulletin gives full data about Translot Filter Blocks for Trickling Filters. Shows typical sections, installation views, etc. Write Cannelton Sewer Pipe Co., Cannelton, Ind.

For All Sludge Dewatering

601. The first filters to be used in large scale operation on primary, elutriated and Guggenheim sludges. Ask for latest engineering Bulletin P.W. General American Process Equipment Div., 10 E. 49th St., New York, N. Y.

Low Cost Air for Sewage Disposal

602. All interested in low cost air for sewage disposal will want a copy of this useful booklet. Describes operating principles and specifications of Roots-Connersville Aerating Blowers. Write to Roots-Connersville Blower Corp., 301 Valley Ave., Connersville, Ind.

Biofiltration for Economical Secondary Treatment

605. Biofiltration means lower first cost of filters, control of recirculation rates, less operating personnel, no fly and odor nuisance. Get all details in bulletin PW today from the Jeffrey Mfg. Co., 947-99 No. Fourth St., Columbus 16, Ohio.

SEE COUPON ON PAGE 93

Save...

Time, Money and Labor in making pipe joints

« « « The only field equipment necessary to make a Universal Cast Iron Pipe Bolted Joint is a Ratchet Wrench.

by using

UNIVERSAL
CAST IRON PIPE

(PIPE and JOINT are ONE)

Outstanding Advantages:

1. *No calking or pouring of lead or lead substitutes. No gaskets used.*
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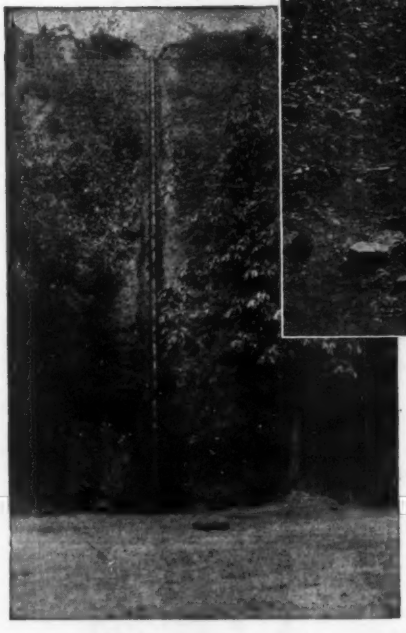
5. Flexibility: Universal pipe is very flexible. It withstands expansion, contraction, unequal settlement, vibration and shock, and electrolysis. Many curves are laid with straight lengths and do not need special fittings.
6. *Universal pipe can be laid on rocky soil, under water and in sub-zero weather.*

Specify UNIVERSAL PIPE for water mains and sewers

Furnished in hot tar dipped, cement lined, and enameline lining.

Quick service to customers: By rail, truck or water from our foundries and warehouses located from coast to coast.

THE CENTRAL FOUNDRY CO.
386 FOURTH AVENUE, NEW YORK 16



Above *All straight lengths of Universal pipe in this curve.*

At left *16" pipe laid on a 45-degree slope. Note deflection at top to level ground without fittings.*

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WATER WORKS

Do Your Water Mains Need Cleaning?

388. Literature on Flexible method of cleaning water mains any size from 2" to 12", giving full details and list of nearest representatives in all parts of country. Address: Flexible Underground Pipe Cleaning Co., 9059 Venice Blvd., Los Angeles, Calif.

Solve Corrosion Problems With This Special Alloy

391. "Everdur Metal" is title of an 8-page illustrated booklet describing advantages of this corrosion-resisting alloy for sewage treatment equipment, reservoir and waterworks service. Dept. P.W., the American Brass Co., 25 Broadway, N. Y. C.

To Measure, Mix, Feed Chlorine or Other Gases

397. Everson SterElators. Bulletins 1063, 1066, 708 and others describe this device for measuring, mixing and feeding chlorine or other gases in solution. Capacities range from ¼ lb. to 2,000 lb. of gas per 24 hours. Address: Everson Manufacturing Co., 214 W. Huron St., Chicago 10, Ill.

All Types of Valves, Hydrants And Fittings

413. Gate, flap and check valves; floor stands and fittings. New catalog No. 34 gives detail information with dimensions for all types of new full line. M. & H. Valve & Fittings Co., Aniston, Ala.

Complete Data on Gates, Valves, Hydrants

414. Gate Valves. Double disc bronze mounted, sizes 2" to 72", hand, hydraulic, electric or pneumatic operating, rising or non-rising stem. Bulletin X. Address: Rensselaer Valve Co., Troy, N. Y.

What You Should Know About Meter Setting and Testing Equipment

431. The most complete catalog we have seen on setting and testing equipment for water meters—exquisitely printed and illustrated 48-page booklet P.W. you should have a copy of. Ask Ford Meter Box Co., Wabash, Ind.

Cast Iron Pipe Handbook—Handy Pocket Size

436. Handbook of Universal Cast Iron Pipe and Fittings, pocket size. 104 pages, illustrated, including 14 pages of useful reference tables and data. Sent by The Central Foundry Co., Dept. P.W., 386 Fourth Ave., New York 16, N. Y.

Cast Iron Pipe and Fittings For Every Need

437. Cast iron pipe and fittings for water, gas, sewer and industrial service. Super-deLavaud centrifugally-cast and pit-cast pipe. Bell-and-spigot, U. S. Joint, flanged or flexible joints can be furnished to suit requirements. Write U. S. Pipe and Foundry Co., Dept. P.W., Burlington, N. J.

Do You Have This Data On Cast Iron Pipe?

438. "Cast Iron Pipe and Fittings" is a well illustrated 44 page catalog giving full specifications for their complete line of Sand Spun Centrifugal Pipe, Fire Hydrants, Gate Valves, Special Castings, etc. Will be sent promptly by R. D. Wood Co., Dept. P.W., Public Ledger Building, Independence Square, Philadelphia 5, Pa.

Concrete Pipe With Greater Elasticity

442. Lock Joint Reinforced Concrete Sewer Pipe, Pressure Pipe, Culvert Pipe, Centrifugal Pipe and Subaqueous Pipe is described and illustrated in bulletins available from Lock Joint Pipe Co., Ampere N. J.

Interesting Facts About Transite Pipe

445. Two new illustrated booklets, "Transite Pressure Pipe" and "Transite Sewer Pipe" deal with methods of cutting costs of installation and maintenance of pipe lines and summarize advantages resulting from use of Transite pipes. Sent promptly by Johns-Manville Corp., Dept. P.W., 22 East 40th St., New York 16, N. Y.

Need a Water-Tight Pipe Joint?

449. Full information on "Hydro-Tite" jointing compound for bell and spigot pipe, together with specifications, instructions; and illustrations both on it and "Fibrex" sanitary joint packing are contained in handsome 48-page booklet. Address: Hydraulic Development Corp., Dept. P.W., 50 Church St., New York.

How to Estimate Quantity Of Joint Compound Needed

450. The uses of Tegul-Mineralead for bell and spigot pipe and G-K Sewer joint compound are described in a 16-page illustrated booklet issued by Atlas Mineral Products Co., Mertztown, Pa. Includes useful tables for estimating quantities needed.

Data on High Efficiency Well Water Systems

454. Installation views and sectional scenes on Layne Vertical Centrifugal and Vertical Turbine Pumps fully illustrated and including useful engineering data section. Layne Shutter Screens for Gravel Wall Wells. Write for descriptive booklet P.W., Adv. Dept., Layne & Bowler, Inc., Box 186, Hollywood Station, Memphis 8, Tenn.

Want Clear, Soft, Iron-Free Water?

467. Water Softening. The use of the Spaulding Precipitator to obtain maximum efficiency and economy in water softening is described in this interesting technical booklet. Permutit Co., Dept. P.W., 330 W. 42nd St., New York 18, N. Y.

Are You Thinking About A Swimming Pool?

472. Data and complete information on swimming pool filters and recirculation plants; also on water filters and filtration equipment. For data, prices, plans, etc., write Roberts Filter Mfg. Co., 640 Columbia Ave., Darby, Pa.

Eliminate Taste and Odor From Your Water

474. Technical pub. No. P.W. 207 issued by Wallace & Tiernan Co., Inc., Newark 1, N. J., describes in detail taste and odor control of water with BREAK-POINT Chlorination. Sent free to any operator requesting it.

Have You a Water Conditioning Problem?

481. Installation-tested equipment for complete municipal and industrial systems or individual units. Illustrated and described in latest booklets from Dept. P.W., American Wells Works, Aurora, Ill.

Treating Water With Copper Sulphate

496. "Use of copper sulphate in water treatment plants" contains valuable data on chemicals, dosage, etc. Ferri-floc Ferric Sulphate—a new, valuable booklet P.W. on coagulation for water and sewage treatment plants. Write Tennessee Corporation, Atlanta 1, Ga.

How to Stabilize Lime Softened Water

498. Engineering Bulletin describes stabilizing lime-softened water by recarbonation, discusses gas production, washing, compressing, drying, and applying the CO (2). Inflico, Inc., 325 West 25th Place, Chicago 16, Ill.

Outdoor Water Service Devices That Do Not Freeze

506. Data on anti-freeze outdoor drinking fountains, hydrants, street washers, etc., contained in Catalog L. Sent promptly on request to Murdock Mfg. & Supply Co., 426 Plum St., Cincinnati 2, Ohio.

Here's Data on All Swimming Pool Needs

508. Well illustrated bulletin describes Filters, Water Softeners, Hydrogen Ion Plants and Complete Equipment for Swimming pools, etc. Copy sent on request by Dept. PW., Chemical Equipment Co., 223 Center Street, Los Angeles 54, Calif.

SEE COUPON ON PAGE 93

Engineering Meetings

The New England Water Works Association will hold its 66th annual conference in Boston, Mass., Sept. 16 to 19, with headquarters at the Hotel Statler.

The 8th annual Water Conference of the Engineers' Society of Western Pennsylvania will be held in Pittsburgh, Pa., Nov. 12 to 14, with headquarters at the William Penn Hotel. H. M. Olson, Ohio Salt Co., Pittsburgh, is general chairman.

Edwin A. Fisher 100 Years Old

Edwin A. Fisher of Rochester, N. Y., one of the grand old men of engineering, is 100 years old this July. For many years he was city engineer of Rochester and 50 years ago he served as the first president of the Rochester Engineering Society. Mr. Fisher was a guest at a recent testimonial dinner given by the Society.

Traffic Surveys

Two excellent publications on this subject have been received from Louisiana—one from Shreveport and the other from Opelousas. These surveys were made by the State Highway Department in cooperation with the cities and the Public Roads Administration. Charts, maps and graphs present valuable data in attractive and easily appreciated form. The studies have to do mainly with growth, origin and destination of traffic, transit problems and parking.

Standard Driveway Plans

The Louisiana Highway Department has issued a 26-page booklet containing plans and sketches for the treatment of private and commercial driveways, and also recommended methods of placing mail boxes along rural highways.

Engineering Data on Conduits

Specifications and descriptions of basic types of cast iron and tile conduits for underground steam, hot water and other lines is contained in a folder issued by Ric-wil Co., Cleveland, O. Trench dimensions and pipe locations for each size and type of conduit are shown, with capacities and sizes required for combinations up to five pipes.

JOB AVAILABLE

City Biochemist. $400 to $500 per mo. plus $48.96 cost-of-living. Two years' practical experience directing biological laboratory or comparable experience; post-graduate training equivalent to M.A. and preferably Ph.D. in one of the sanitary sciences. Applications received until needs of service filled. Write Personnel Department, City Hall, Madison 3, Wisconsin.

Advertising Index

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VOL. 78 — PUBLIC WORKS — No. 8

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AUGUST, 1947

When you need special information—consult the classified **READERS' SERVICE DEPT.**, *pages 69-73*